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SAWYER-MAN ELECTRIC CO.,

COMMERCIAL AGENT OF THE CONSOLIDATED ELECTRIC LIGHT CO.

No. 510 West 23d Street, New York,

August 1st, 1888.

To all Users of Incandescent Lamps:

Experience has demonstrated that the life and utility of the Incandescent Electric Lamp is increased and the cost of its manufacture diminished by a decrease of the electromotive force. We have, therefore, decided to divide our commercial lamps into three classes, viz: HIGH, MEDIUM, AND LOW VOLTAGE LAMPS; of which classes, 100, 75, and 50 volts, respectively, shall stand as the types.

THIS COMPANY, THE FIRST TO GIVE TO THE CONSUMER THE BENEFIT OF SUCH CLASSIFICATION, IS ENABLED, BY REASON OF INCREASED MANUFACTURING FACILITIES, AFFORDED BY THE ENLARGEMENT OF OUR NEW YORK AND PITTSBURGH FACTORIES, AND BY REASON OF VALUABLE IMPROVEMENTS MADE IN THE LAMP, TO OFFER THE FOLLOWING REDUCTION IN PRICES FOR LAMPS WITH OUR

STANDARD BASES

SUBJECT TO DISCOUNTS FOR CENTRAL STATION USE AND TO PURCHASERS OF ORIGINAL PACKAGES OF 250 EACH.

C. P.	50 Volt.	75 Volt.	100 Volt.
16, and under,	$0.70	$0.75	$0.80
20,	.75	.80	.85
24,	.80	.85	.90
32,	.90	.95	1.00

THREE CENTS WILL BE PAID FOR THE RETURN OF EVERY LAMP BASE WITH THE PLATINUM WIRE INTACT, DELIVERED IN GOOD ORDER AT EITHER OF OUR FACTORIES.

For the purpose of obtaining uniformity of production, and of reducing the cost of manufacture, we offer to purchasers of our lamps our Standard Sockets, without charge, in exchange for any other socket in use by them.

CORRESPONDENCE SOLICITED.

SAWYER-MAN ELECTRIC COMPANY.

ELECTRICAL REVIEW

ILLUSTRATED.

A WEEKLY JOURNAL OF

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THE TELEPHONE MEN.

Bright and Alert as of Old They Take Possession of the Hotel Brunswick This Week.

THEIR NUMBERS NOT SO LARGE, BUT THE QUALITY OF THE FINEST.

WHO ARE HERE AND WHAT THEY DID—FINE PROGRAMME IN WHICH ROYAL ENTERTAINMENT RELIEVES THE HARD WORK.

The men who compose the telephone fraternity are welcome everywhere. New York is proud to greet them this week. They are here in annual convention at the Hotel Brunswick, convening at 11 A. M., Tuesday. There is no lack of spirit and life and old time enthusiasm, and the number in attendance is about the same as formerly. Some of the Western members say they were offered the New York trip by their directors as their vacation, but they have generally found hard work to rule the day at all these gatherings. And this is largely true, but thanks to the generosity of the Metropolitan Telephone and Telegraph Company, and of the American Telephone and Telegraph Company, and the Western Electric Company, the telephone visitors this week will find some royal and useful entertainment as announced elsewhere provided for them, and we are sure they will enjoy it, just as the hardworking man always enjoys his season of play.

TUESDAY'S PROCEEDINGS.

FORENOON SESSION.

President Henry Metzger called the Convention to order at 11 A. M., some 70 gentlemen being present.

The Executive Committee at its meeting decided the programme as follows: Tuesday morning, beginning at 11 o'clock and continuing until 1 P. M. Tuesday afternoon an executive session at 2:30, and an open session afterwards until 5 o'clock.

Wednesday's sessions from 10 A. M. until adjournment at 2:30 P. M.

The roll call by Secretary C. H. Barney showed that 26 companies in active membership were represented, and that two associate members and five honorary members were in attendance.

President Metzger then introduced Mr. Henry C. Davis president of the Electric Club, who extended to the Association the privileges of the club house.

Secretary Barney then read his report showing that there were upon the roll 36 active, 5 associate and 29 honorary members. The routine work of his office had been much the same as the previous year. The publication of the *news letter* had been continued, and it had been his privilege not only to visit the more important exchanges in New York and vicinity, but many others at distant points including Boston, Providence, Philadelphia, Pittsburgh, Cincinnati, Chicago, Minneapolis and St. Paul. The receipts of the year were $1,937.69, and the expenses $1,953.17, thus drawing slightly upon the surplus of the previous year. The report was accepted and filed. Then followed the treasurer's report. The report was referred to the Executive Committee for examination of details.

TREASURER'S REPORT.

Treasurer H. L. Storke made the following showing in his financial statement. Although the expenses for the year slightly exceeded the income, all bills have been paid to date, and there is still a balance in the treasury of $21.85.

Amount collected for dues	$1,900.00	
Initiation fee	10.00	
Extra sales of proceedings	27.69	
Total	$1,937.69	
Balance in hand	37.33	
Total		$2,075.02
Secretary's salary	$1,200.00	
Rent for office	120.00	
Printing Pittsburgh proceedings	221.25	
Other printing	138.80	
Office expenses, postage, etc	152.51	
Stenographer—Pittsburgh	50.25	
Other expenses	61.36	
Total	$1,953.17	
Balance on hand Sept. 4		$21.85

Mr. Tyler of New Haven nominated Mr, Metzger to succeed himself as president. The nomination was seconded by Mr. Sargent, and upon his motion the secretary was unanimously authorized to cast the ballot of the Association for Henry Metzger of Pittsburgh as president.

Mr. Metzger accepted his election in a very appropriate address in which he called attention to the thoroughly effective manner in which the Association had carried out its work of gathering and tabulating the telephone satistics of the exchanges throughout the country. At the last meeting there was a feeling of doubt and uncertainty as to the future of the Bell patent which had been happily dispelled by the decision of the U.S. Supreme Court. He thought the thanks of the Association were justly due to the efforts of J. J. Storrow and E. N. Dickerson for the masterly manner in which they had defended the patent of Alexander Graham Bell.

In spite of the favorable decisions of the the court, however, he believed that the best interests of the sub-companies demanded that they should carefully prepare for the future. That there was a widespread demand for cheaper and better service, and that by preparing to comply with it, they could best forestall the designs of future competitors. The decision of the Supreme Court had done much to create a feeling of security among the stockholders the result of which had been shown by the erection of suitable buildings for the companies in the more important cities, and general improvement in the construction of lines, and the use of better material. In conclusion he returned his sincere thanks to the Association for their kindness to him as shown on various occasions since he first met with them at Niagara Falls.

The following officers were re-elected:

W. D. Sargent, Vice-President, H. L. Storke, Treasurer, M. F. Tyler, Member of the Advisory Committee, and Messrs. S. M. Bryan and G. N. Stone, Members of the Executive Committee. W. J. Denver and C. F. Cutler were elected as new members of the same committee.

Invitations were extended for dinners, excursions and entertainments as follows:

From the American Telephone and Telegraph Company, a drive on Wednesday afternoon through Riverside and Central Park to the Mount Saint Vincent Hotel, where the members and friends will become the guests of the Western Electric Company, at a banquet to be served at that house. On Thursday the Metropolitan Telephone and Telegraph Company will provide an excursion from the foot of West 23d St., at 10.30 A. M., to West Point and return, after which the delegates will witness the "Fall of Rome."

Upon the motion of Mr. Storke the various invitations were accepted with thanks.

The technical business of the meeting was opened with an able paper by Mr. F. A. Pickernell, on Telephone Batteries, which will appear in full in our next issue. The paper was highly complimented, and elicited favorable comment from Messrs. Lockwood, Gifford, Baily and Thornberry who took part in the discussion.

TUESDAY AFTERNOON SESSION.

At 2.30 the Convention met in Executive Session, only full members of the Telephone

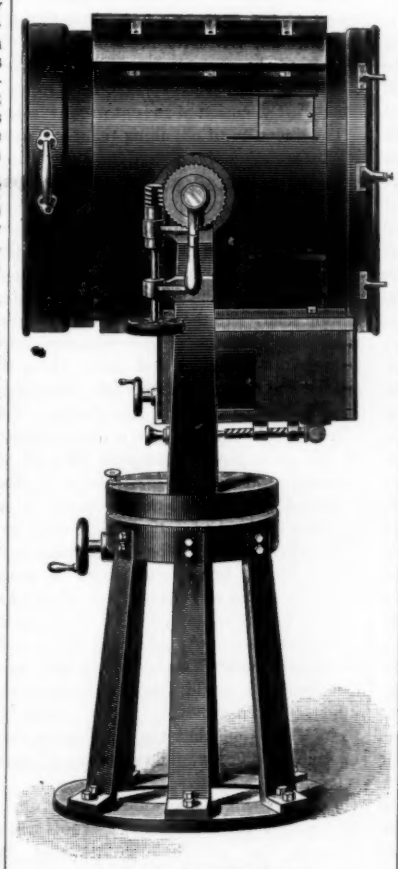
(*Continued on page 5.*)

The New Thomson-Houston Search Lamp.

The new Naval Projector manufactured by the Thompson Houston Electric Company meets the prime requirements of steadiness and intensity of light, ease of manipulation, and durability under severe conditions of climate to which all sea-going apparatus is subjected.

Its arc lamp, which is made from 4,000 candle-power upward, is fed by hand. The carbons are so inclined that the "crater" carbon throws the full force of the light to the reflector at the back.

The reflector is a concave-convex lens of great precision, silvered on its back surface. The light passing from the arc at the focus undergoes refraction in the lens, and being



ELECTRIC SEARCH LAMP.

reflected from the silvered surface, emerges in parallel rays. As will be seen in the illustration, all the wheels and handles for controlling the direction and feed of the projector are situated so that the operator may station himself directly behind the lamp and work without changing his position.

This Naval Projector, by reason of its great power and accurate adjustment, is especially adopted for use on ships of war.

The Thomson-Houston Electric Company, however, manufacture another type of Search Lamp suited to all the needs of the merchant marine, and also a small size for steam yachts.

You will find the REVIEW all comprehensive this week, and every line of interest.

A GREAT CONVENTION

Three Hundred Persons Attend the New York Meeting of the National Electric Light Association.

AN ABLE AND COMPREHENSIVE OPENING ADDRESS BY PRESIDENT DUNCAN AND A BRILLIANT SPEECH OF WELCOME BY MAYOR HEWITT.

MANY VALUABLE POINTS MADE IN THE ADDRESSES AND DISCUSSIONS.

THE QUESTION OF UNDERGROUND WIRES EXHAUSTIVELY TREATED.

NEW CONSTITUTION ADOPTED AND CHICAGO SELECTED AS THE NEXT MEETING PLACE.

The wise counsellors and managers of the National Electric Light Association made no mistake in selecting New York as the place of holding the Eighth Semi-Annual Convention. The attendance was larger, and the enthusiasm more pronounced than at any previous gathering of the Association. Interest in electrical work is constantly increasing, and this intelligent, alert, and very comprehensive organization is fulfilling its mission as the centre, the focus, of it.

When President Duncan commenced his very interesting opening address, he had an audience of probably 350 persons, a number of local visitors being present.

The Subway Commissioners of New York and Brooklyn were represented. The address was applauded at its close, and then, in a few graceful words, Mayor Hewitt was introduced, and received with applause. His address, which we are pleased to publish in full, was a rare treat to the electric light men, and, as was remarked by many, they would like to meet in New York every year if they could be privileged to listen to so much eloquence, humor and sound sense as greeted them on this occasion. The Mayor was in his happiest vein, and his remarks were applauded to the echo.

The proceedings, in detail, which will be found found to be full of vitality and extraordinary interest, are published in full herewith, with the exception of a few important papers which will appear in subsequent issues of the REVIEW.

WEDNESDAY'S PROCEEDINGS.

The Convention was called to order at 12 M. on August 29th, in the banquet hall of the Hotel Brunswick, by the President of the Association, Mr. S. A. Duncan, of Pittsburgh, Pa.

The President addressed the Convention, as follows:

Gentlemen of the National Electric Light Association in Convention Assembled:

When this Association, after six months of existence, last met, in this great City of New York, three years ago, but sixty gentlemen were present. To-day we are over three hundred, in other words, the attendance has increased five fold. I am, therefore, able to congratulate you upon the growth, prosperity and stability of this organization, in whose welfare we are all so deeply interested, and in whose commercial usefulness, we all take

pride, for we have all had a hand it its making. And I am also able to congratulate you upon that which is more important than numbers—and that is the fact that this Association is rapidly becoming the center of all matters pertaining to the arts which depend on the application of powerful electric currents, and that its proceedings are watched with growing interest by not only the whole electrical public of this country, but also abroad. It is sometimes interesting to notice how we are regarded beyond those limits which properly come within our jurisdiction; and I would call your attention to a fact—which is certainly not uncomplimentary—and it is this: Although, during the early days of our history, the technical papers abroad paid no further attention to our proceedings than to ridicule them, yet of late, and more noticeably for the last six months, almost every paper which has been read before this Association has been copied by the leading electrical papers all over the world. And can there be a stronger indication of the growth of the industries which have been fostered by this Association than the fact that they support in this country no less than eight journals devoted exclusively to electrical matters? This prosperity, upon which we have been mutually congratulating ourselves, has been due not only to the commendable efforts of the rank and file of our membership, but also, in no small degree, to to the good judgment, perseverence, untiring energy and marked ability of our honored past president, Mr. J. F. Morrison, and the able committees which have assisted him in administering the affairs of this Association.

But it is of more importance to us to consider the present state of the industry. From time to time, statistics as to the amount of electric light apparatus in use in this country have been presented to the Association. At Pittsburgh it was estimated that there were no less than 4,000 isolated plants and central stations, operating 175,000 arc lights and 1,750.000 incandescent lights. To these figures we may now add that there are 1,351 new isolated plants and central stations, operating 35,201 arc lights and 393,944 incandescent lights, of which I have a detailed record. By adding this increase to the figures of six months ago, we find that there are now 5,351 isolated plants and central stations, and there are burning every night in the the year, in the United States, no less than 192,500 arc lights and 1,925,000 incandescent lights. We may also add that there are 459,495 horse-power of steam engines devoted to electric lighting. Figuring this in coal consumption, it can be demonstrated that in the year of 1888 enough coal will be consumed in the United States, for electric lighting purposes, to make a solid column 100 feet square and over a mile high. It may be here parenthetically remarked that there has been an increase in the capitalization of the electric light companies of the United States, in the last six months, of not less than $42,210,100.

But we have not yet touched upon the great industry of the electrical distribution of power. There are, at the present time (of which we have a record), 34 electric railways completed and in operation in the United States, having an aggregate 138 miles of single track, and operating 223 motor cars, and utilizing 4,180 horse-power for stationary engines. There are, also, now in process of construction 49 other electric railways, aggregating 189 miles of single track, which will operate 244 motor cars, and at the present time there are constructed and being constructed 83 electric railroads, aggregating 327 miles of single track and operating 467 motor cars. In this connection it must be remembered that there are 39 other electric railroads incorporated which have not yet begun construction. It is also estimated that the electric cars now in operation in the United States will carry, in the year 1888, no less than 17,045,500. It can be better imagined than estimated what will be the ultimate outcome of an industry which has arrived to such a degree of development in three years.

In view of the difficulty of compiling statistics on such small unities, it has been impossible to collect reliable information relative to the stationary motor business; but we know that at the present time, it has stimulated capital to such an extent, that there are single factories employing no less than 1,500 hands each in the manufacture of electric motors, and, at no far distant day, all large cities will have their power stations of several thousand of horse-power each, distributing energy throughout every ramification of industry. So rapid a development of this new industry into gigantic commercial proportions should be an admonition to the electric light companies now in the field, to reap the harvest which is ripe to their sickle, and not to wait for competitors to come within their field of operation, in the shape of power stations; for these people once established, will reach out and take in a large portion of the electric lighting business.

The present meeting of this association gives promise of being one of the most interesting so far held. The report of the secretary and treasurer shows the Association to be in a gratifying financial condition, there being a balance of $1,000 in the treasury after the payment of all bills, and the membership is steadily increasing. The proceedings of the last four conventions have been printed and furnished with a thorough cross index, and each member has been provided with a copy. The admirable way in which the proceedings have been printed reflects credit upon the executive committee, under whose direction it has been carried out, and the carefully compiled cross index, the accurate technical proofreading of the publishers of *Modern Light and Heat*, deserve creditable mention. The report of the executive committee through its chairman, Dr. Otto A. Moses, and the reports of the several committees, together with the following papers, should command the closest attention of the entire convention.

The difficulty of obtaining reliable statistical information in regard to the various electrical industries, and, also, for the purpose of giving continuity to the whole Association from one convention to another, warrants the president in urging upon the Association the necessity of establishing a permanent office which shall be a repository of all information relative to the allied electrical industries, and a means of intercommunication between its members, and from which the officers and executive committee can administer the affairs of the Association. This office should contain a good reference library of electrical works, complete files of all domestic and foreign electrical and other electrical journals, and the repository of the archives of the Association. It should be a place where every member of the Association should feel at home, and where he would naturally go for any electrical or other information that it contained. A very slight increase in the running expenses of the Association would maintain such an office, and, when established, it would, from its innate value, increase the membership of the Association to such an extent that the running expenses of such an office would take care of themselves.

Does not this Association, having, during its years of growth spread its roots widely through the electrical industry of this country, stand upon the eve of becoming much more widely influential than ever before by carrying out the suggestion of Mr. Frank Ridlon, at the convention in this city three years ago, which was further elaborated by a committee specially appointed for that purpose, which reported, through its chairman, Dr. Otto A. Moses, at the Detroit convention, and was still further advocated by Mr. Arthur Steuart, Mr. E. R. Weeks, and Mr. A. J. DeCamp, at subsequent conventions, namely, the establishment of a permanent headquarters as already sketched out?

Gentlemen, in conclusion, I will say that in no way can you better assist the chair in the discharge of his duties, and, in no way can you aid in making this convention a thoroughly successful one, than by a constant attendance at its sessions. I know that the more than generous hospitality in the shape of various entertainments, as mapped out by our New York friends, may tend somewhat to distract your minds from the serious business for which you have assembled, but I also know that you can find ample time, not only to accept of their hospitality, but to give to this convention your entire time and attention during its sessions.

The President: Gentlemen, it affords me great pleasure to have with us this morning a gentleman of national reputation, with whose name you are all familiar. I have the honor of introducing the Hon. Abram S. Hewitt, Mayor of the City of New York. (Applause.)

Mayor Hewitt: Mr. President and Gentlemen of the Convention: My duty on this occasion is as easy as it is agreeable. I am here to bid you welcome to the City of New York, and to tender you such hospitality as the Mayor of this city has it in his power to tender. To distinguished strangers I think the usual form is to give the freedom of the city in a gold box. If you will leave out the gold box I can tender you the freedom of the city, but exactly what it is I do not know. (Laughter.) But to those who are strangers here I trust it will be found exceedingly pleasant and highly profitable.

I gather from the remarks of your president that you are here to take an account of stock of what you know about electrical science and its application to useful purposes. I think it will be easier for you to ascertain how much you know than to find out how much you do not know about this subject. (Laughter and applause.) And in the last part of that inquiry I am in entire sympathy with you. (Laughter.) When I have professed, as I have had to do on various occasions, that I did not know anything about this subject, it has been received with incredulity; but you who do know something about it know that I am exactly right. When you reflect upon what you have to do, you must be rather appalled at the magnitude of the contract. This Convention must strike the average uninstructed mind pretty much as a meeting of astrologers in the anti-Christian era would have done throughout the Orient, or a convention of necromancers or magicians during the Middle Ages. You deal with something to the popular mind very mysterious, almost incredible. You have already performed wonders which, even to the most intelligent men, can only be regarded as miraculous. You stand to-day pretty nearly in the condition in which Watt, one hundred and ten years ago, must have found himself when he produced the first perfected condensing engine. Crude forms of engines had been in use, doing more or less effective work, prior to his day, but in 1776, the year of our emancipation from foreign control, Watt produced the first real working machine.

Now, what has been done in 110 years? There are still living in the world men who were alive when the first engine began to do its work. Could any man, if he had been gifted with the power of prophecy—could any man have foreseen the transformation which the whole world would undergo in a century from the time of that great invention? Can you conceive of the world without a steam engine? Could the population which now inhabits the globe survive for 60 days if the steam engine were withdrawn from use? Would civilization have even an apology for existence to-day without the steam engine? Now, gentlemen, looking back, you can see how the application of one great motive force can transform the face of the universe. Looking forward, is there a man here who can tell us what this new electrical force is going to do for the world? Can any man say how it is to be enriched, how it is to be purified, how it is to be exalted from the depths of poverty and suffering in which in many parts it is plunged? If electricity, like air and water, could be made free to the hand of labor or to the wants of men, could be turned on by tap, so to speak, either without charge or at a merely nominal cost, don't you see that all monopoly would cease to exist? For monopoly consists in nothing but the power to appropriate force to personal and private use. If all force and all power were made free to all men, isn't it apparent that the inequalities of fortune and almost all the evil of which mankind complain would disappear? Is there anything more astonishing in this prospect than in the retrospect which you can all take of the work that has followed the introduction of the steam engine? I used to be told when I was at school—I don't know how it is now—that the earth is a great magnet. You may have changed all that, but I hope you have not, for I do not want to lose what little I do know. (Laughter.) We used to be told it was a great magnet, and that it revolved on its axis once in 24 hours, and that it was 25,000 miles in circumference. Now, that strikes me as the definition of a mighty large dynamo. If a great magnet 25,000 miles in circumference is put in revolution so as turn on its axis once in 24 hours, from what I have seen of the dynamo it strikes me that there must be a vast, incalculable fund of electricity produced by that operation. (Applause.) I know nothing about it, I may be talking nonsense; but, at the same time, if that be true, and if it be true of the whole planetary system, and of the whole universe of the Divine architect, what a vast fund of unappropriated power there is for mankind in the future; and knowledge is power, and power is wealth, and wealth, which is free to all who have got the brains to take it, is the benefaction of mankind, and the opening of the gates of the millenium, if we are ever to see it, will be accomplished by you gentlemen and those who will come after you, for this is the only course that I am able to see by which the goodness of God, the bounties of Divine Providence can be distributed with a free hand to all the world and to every man, woman and child within its bounds. (Applause.)

Upon the borders of this land of dreams we stand. You are slowly raising the curtain of the future. I shall not see the drama played out; but there are men in this room who will live to see society transformed by this new agency; for it is a curious and suggestive fact that all moral forces and all moral questions find their final resolution in the facts and laws of physical nature. There is where you come at last. If this world is a better world to-day, a richer, a happier, a more enlightened world to-day than it was a hundred years ago, it is due mostly to the steam engine and its applications. If it is to be, as I believe it is to be, a better world, year by year and century by century, it will be due to the discoveries and applications of electrical force, or of some other force which possibly may be hereafter ascertained and developed; but to-day we must call it by the name which you and I know it by—the electrical force.

Hence, I bid you welcome to New York. I am glad to see you. You are benefactors. You come to two millions of people with a gospel. You are the apostles of a new industrial dispensation. You are distributors of this overgrown wealth which you hear is in few hands in this great city. It cannot stand your attacks. It has withstood the preacher and the moralist and the philosopher; but it will not stand against the scientist who discovers the laws of nature, and who makes them free to all who will drink at the fountain of science. (Applause.) Yes, you will revolutionize the world; you will regenerate society; and it is none the less to your credit that while you are doing it you are making your living, and getting an honest compensation for your labor—(applause)—for it is a law of Divine Providence that utility and beneficence shall march hand in hand down the highways of civilization. They are bound together by a Divine Law, and you are the executors of that law when you open new fields of discovery, new germs of value, new applications to useful purposes. Of course we bid you welcome, and we bid you welcome because we feel that we are so ignorant, and need your help. We are engaged in this city in undertakings which require from you your honest and best judgment. We send messages by wire through our streets. We light them by conductors perched upon poles through the streets. We talk through a net work of wires so thick overhead that often the sky is obscured. They are not pleasant to look at, but they are indispensable, in the present state of knowledge, to the business of society. (Applause.) The man who would disturb them until something better is found out, and proved to be found out, would be a barbarian. (Applause.) Still, like the Mayor, they have got to go. (Laughter.) But the Mayor is too old to go at a 2.40 gait—(applause)—and he likes to see his way clear before he takes a step. Now, in order to clear up this matter a little for you who know so little, as I have said, about this subject, and I knowing so much, let me say that this much seems to have been found out at some cost to somebody, I do not know who, that it is quite feasible to put underground all the telephonic and telegraphic wires, and in fact all wires which carry low tension currents. I suppose that is now demonstrated, and I trust that in a very short time this city will be relieved from the unsightly telegraphic wires, telephonic conductors, and from any modes of diffusion for incandescent lighting which still remain above ground. I suppose that is all feasible. The question what to do with the high tension current remains.

First, we ask you to tell us—at least I ask you to tell me, because there are some people here who know more than I do—whether a satisfactory mode of cable transmission for high tension currents underground has yet been devised. I understand that a cable for the Brush Company is about to be laid in one of the conduits which have been constructed in Broadway, and I suppose that will test the question as to the feasibility of the transmission of high tension currents practically and economically, because there is no sense, you know, in things that don't pay; if is too dear we have got to give it up. (Applause.) I suppose that will test the question, and I am very glad of it. I have

been censured—possibly by you electrical gentlemen; I do not know—very much, for not having taken steps to coerce all these lighting companies into putting cables under ground until that question was settled. Well, I am no longer a young man. I have had a long experience in life. I have done a pretty large business in my time. I have had to deal with very difficult problems, and I have learned that the part of wisdom and of true speed is to go slowly and to ascertain your facts and get your knowledge, before you undertake to re-construct the universe. I have been very desirous that this matter should be tested—this question of transmission of high tension current underground at the earliest possible moment and I congratulate you on the fact that it is going to be tested by a responsible company, and until it is tested, let me say to you frankly that if it were in my power to compel the other companies to do this thing now to-day, I would not do it. (Applause). I should look upon myself as an everlasting fool (laughter) who ought to be consigned to eternal seclusion in a madhouse if I did such a thing. But I hope it will succeed, and if it does succeed no public officer will be more prompt than I shall be in compelling every electric light company to respect the intention of the Legislature when it confided this great work to four men who did not know anything about what they were going to do. (Applause). The Legislature evidently recognized the fact, which you recognize and I do, that what we don't know about electricity is a good deal more than what we do know about it, and so they picked out four men who were supposed to understand politics if they did not know anything else. (Applause). I speak this frankly, because I am one of the four men. (Laughter and applause). I should be the last man to cast any imputations upon my colleagues who have charge of this most interesting and important public work; but I think that we shall all of us be wiser—my colleagues as well as myself—after a little more experience has been gained upon the subject to which I have referred.

Now the second question is this: When the cable is underground and works successfully, will you kindly inform me and the public, through whom I communicate with you, whether a satisfactory system of distribution has been discovered and put in practice. It is one thing to put the current underground and another thing to get it out so that there may be lights. Now, I know nothing about it; I have simply made inquiries of every intelligent electrician that I could meet, and up to this time I have not been able to ascertain that there is a satisfactory mode of distribution. Now you know whether there is or not. If you should say to me, after a discussion of the subject that there is, I should accept your judgment as final, because you embody all that there is known of this abstruse subject, and if you, by your resolution, say that there is a proper and comprehensive system of distribution so that the evils that are complained of will be abated and that there will be absolute safety in the distribution, then my mouth will be closed and I shall act upon your judgment; and that is the reason why I have come here chiefly to-day, not simply to welcome you as strangers and guests from abroad, but to ask you to consider this subject coolly, dispassionately, intelligently, and give us the results of your discussion, so that we may act coolly, dispassionately and intelligently in carrying out the law.

Now as to the matter of danger. The newspapers have teemed during the last year with sensational articles pointing out the great danger of the present system. Remember I do not like the present system. I regard it as—I was going to say—barbarous. The streets should not be defaced. We should not have these wires running about. But let us get at it on proper grounds—asthetic grounds, if you will, scientific grounds, economical grounds—any other grounds than prejudice and sensation. Those I take no stock in, and I will never allow myself, and I trust no man who is a lover of truth will allow himself to be dragooned by the newspapers into doing what he believes to be wrong. Now is this dangerous, will you kindly tell us? I thought it was exceedingly dangerous; I went into office with the impression that every man who went out in a street lighted by a high tension current took his life in his hands, and I was as anxious as anybody to get them removed; but when it became my duty to look into the matter, I found that in proportion to the amount of work done, measured by our friend, the President's column of coal, if you like, or by those other things that you call ohms and volts, and which my colleagues are flinging at the Common Council pretty much as that distinguished millionaire at Saratoga, turned out his gems among the boys the other day (laughter)—I am sorry I was not there by the way; I was about fifty miles away; when I heard of it I made tracks, but I could not get there. Perhaps my colleagues got there. (Laughter.)

Well, I found, measuring this industrial element, call it what you like—some name you must call it—this force, this power—measuring it by the work it was doing and ascertaining the accidents that occurred, to my astonishment I found that we had more accidents daily from the horses in the streets—infinitely more; that we had more accidents with steam engines; that even the building of houses in the city caused more deaths every year—infinitely more deaths in this city than this particular agency. I was therefore driven to the conclusion that considering the work it was doing, comparing it, if you like, with the illumination by gas, that it was positively safer, just as the railway had proved to be safer than the stage coach and the stage coach probably safer than walking, for the number of people carried. I found that with all the difficulties with this thing, the absolute results seemed to show that it was absolutely safer than any other useful agency at work in this city. I may be wrong; but that was the conclusion to which I was forced. But then when I investigated the cause of the accidents I discovered that they were not due to anything that was inherent in the transmission of the current overhead; but it was rather due to two causes, either the carelessness of the company in inspecting its installation and keeping it in good order or in the carelessness of the person who came in contact with it—one or the other.

Now there is no excuse for the company, not the slightest. They undertake to render a public benefit; they are paid for it; they undoubtedly ought to see that their plant is in the most perfect order possible, and any company that neglects to keep its plant in proper order is of course liable to the penalties of the law, and I would be the first to have the officers of such a company indicted, if I could. But I take it that the duty has been on the whole pretty well performed, because the accidents have been so few. They have been very few indeed. I believe that in this city there are but four cases of death in consequence of any difficulties with the wires themselves. There may have been some other causes, but I think there are only four direct deaths. I may be in error. It is either four or seven, but I believe it is four.

(There have been five charged to electricity.—ED. REVIEW.)

Now, under the circumstances, the thing that would seem to be wanted – and I think it will be wanted when you come to your plan of distribution, just as much as it is wanted now—is a thorough inspection of the means by which the light is made available to the public above the ground, and that inspection should, in the first place, be made by the companies themselves, who have the greatest interest in the matter and the largest duty to perform, and I fully agree that the public, who have a great interest in it, should also have thorough inspection, and the reasonable rules and regulations which may be adopted by the body that is charged with the custody of this matter, should be implicitly obeyed, and any violation of them ought to be severely punished. But I would like you to consider the whole question, not merely the distribution, but if you come to the conclusion that no adequate mode of distribution has been found which will dispense with the present mode, then that you will consider and advise us how we can make it safer to the public and thereby more economical and useful to the companies who supply the lights. These are questions of such paramount interest in this city that your presence here is most welcome. I trust you will give us the benefit of your knowledge, and when you do not know, I hope you will say so, and confess your ignorance like men, for that is what I have been doing now and what I intend to do so long as I am Mayor. Gentlemen, you are welcome to New York. (Long applause.)

The President: Your Honor, in accepting on behalf of the Association, the freedom of the City of New York, I desire to confess that I do not know what it is, but I might state to your Honor, that in some of the cities where I have been, the Association have practically taken control of the city for the time they have been in it. They have exercised the functions of Mayor, Board of Aldermen, and other offices which the American citizen can fill, and they would have taken anything else that was available.

In regard to the consideration of the points brought forward by his Honor, in his address, I desire to say that this whole question will be considered to-morrow morning at 10 o'clock, when we shall be very glad to have his Honor present with us. We have already extended an invitation to the members of the Subway Commission and others who are interested in this matter, and we are seeking for all the light we can obtain on this subject. We have come to consider this matter calmly, coolly and dispassionately, not only for the interest of the public at large, but for the interests of the electric lighting companies, and I can assure you, sir, that we will consider this matter in the spirit in which you have suggested.

I now declare this Convention open for the transaction of such business as may be brought before us.

The first business in order is the report of the Secretary and Treasurer.

The Secretary presented this report, which is as follows.

TREASURER'S STATEMENT.

Baltimore, August 25th, 1888.

Report of the Treasurer of the National Electric Light Association.

Feb. 18	To Balance.....	$971.67
	Dues received from February 19th to Aug. 25th...	1,480.00
	Contributed from Westinghouse Companies at Pittsburgh.....	1,150.00
	Contribution from Chas. Schieren, N. Y.....	50.00
		$3,651.67
	Disbursements.	
	As per detailed report....	1,716.44
		$1,935.23

The President: Gentlemen, you have heard the report of the secretary and treasurer. It is now before you. Do you desire to take any action in regard to the same? If there is no objection it will be received, filed and printed.

The secretary read a letter from Mr. George Worthington, editor of the ELECTRICAL REVIEW, inviting the members of the Association to visit the "Fall of Rome"; also an invitation from Mr. Theodore Moss, to be present at a performance at the Star Theatre; also an invitation from the Okonite Company, to attend a performance at the Broadway Theater, Thursday evening; also an invitation from the Electric Club to all the members, to visit the Club house during their stay in the city.

Mr. C. A. Brown, of Chicago: I would move, you, sir, that a committee of five be appointed to select the place for the next meeting of the Convention of the Electric Light Association, and to report to this Convention. The motion was seconded and carried.

The President: Your attention is called, gentlemen, to the various invitations which have been received here, and I have no doubt you will bear in mind the procurement of tickets at the proper places for the different entertainments. At to-morrow's session of this Association we shall read the notices pertaining to the entertainment for Thursday evening, and on Friday we shall read the notices of the entertainment for that evening, so as to refresh your mind.

We will proceed with the order of business and take up the report of the committee on the testimonial to Mr. J. Frank Morrison.

Mr. Martin: Mr. President and gentlemen, in accordance with a resolution adopted at the Pittsburgh meeting, the resolutions there passed with regard to the services of Mr. J. Frank Morrison to the Association have been engrossed. I am the chairman of that committee, and have the resolutions in my hand, and I believe that it would be in keeping with the wish of the meeting, if, before the presentation of the engrossed resolutions, they be read.

Mr. Martin then read the resolutions, which were published by the REVIEW six months ago.

Mr. Martin: Mr. Morrison, I have the greatest pleasure, in the name of the Association, in tendering you the engrossed resolutions which have just been read. (Applause.)

Mr. Morrison: This is perhaps the first occasion since my acquaintance—my intimate acquaintance with the gentlemen who composed the National Electric Light Association when I have been glad that I am not very well. I find at this very agreeable surprise party, which you have prepared for me and which it is a wonder has been kept quiet where so many men knew it, that I am almost unable to talk, and you know what a terrible thing that is to me. I accept the gift which you have presented, and I think it is needless for me to say to you, and I think you will believe me when I say, that I fully appreciate the spirit in which it is tendered. At the start, this Association required, perhaps, different material in its presiding officer from that which it requires to-day. I believe that for the first year I filled the bill fairly well. I do not flatter myself very much. I believe that after the first year a man more bending and more conciliatory than I am, perhaps, would have filled the bill better. Through your kindness and indulgence I was continued in that honorable office until last February, when you kindly permitted me to retire. For that and the beautifully engrossed resolutions expressed in such kindly terms I now thank you. I am not out of the service by any means. I hold the honorable position of a member of the Executive Committee, and I do not propose to be a dead head in that or any other part of this enterprise. I am at your service now, gentlemen, as I was before, and I expect to remain in the service so long as the National Electric Light Association exists and I live. I thank you for the compliment. (Applause.)

The President: The next business in order is the report of the Chairman of the Executive Committee. I see he is now present. You will hear that report.

Dr. Moses: At a meeting this morning of the Executive Committee preparatory to the beginning of our exercises, I announced that, owing to the pressure of circumstances and the numerous arrangements that had to be made, I had not been able to prepare a report of the Executive Committee. A gentleman who has just left here said that sometimes in weakness there may be strength, meaning by that, that having no report to make, perhaps I might get over it quicker than I might otherwise do. The facts are we have been doing as Dr. Arnold did when he said, "A teacher is a man who is striving all the time to make himself useful." The Executive Committee of this Association has striven so far to become a vanishing point, a zero at this moment, and now the Convention has taken the matter into its own hands, and the Executive Committee has disappeared below the surface. Our only function was that which is generally given to executive committees, to arrange matters, to bring them into some kind of shape, and chance has a great deal to do with the forming of that. I took, with a great deal of diffidence, the position of Chairman of the Executive Committee. It is our custom always to select the committees as much as possible from the localities in which the Convention is going to meet. They fixed upon me, perhaps, because they thought I was not as busy as other members of the Executive Committee, but I find it is a pretty arduous duty to please all, to offend none, and to act according to one's best conscience in the matter, to be sure that your reason guides you, to be employed all the time for doing something for the benefit of the Association and in making no mistakes, and I tell you I have had my hands full.

Gentlemen, the Executive Committee has no report to make beyond this that they deem themselves exceedingly fortunate that the turn of events has allowed the Mayor of the city to-day to open up so beautiful a field as he has done. Our business largely shapes itself, and the discussion that will take place to-morrow will be one of great local importance here, and will give zest, I hope, to the entertainment that you will receive of both an intellectual and a physical character. I happened to be called away in attendance upon the Mayor a while ago, and I do not know whether the secretary announced that we had received many kind invitations from friends in the city to participate in the enjoyments that they have extended to us. I can only say, gentlemen, that in those I have had but a very small part. It was a spontaneous offering on the part of very liberal hearted gentlemen in the city and I hope you will be able to enjoy them to your hearts content. Gentlemen I have nothing further to say. (Applause).

The President: The next business in order is the report of the Committee on the Constitution of which Mr. A. F. Mason, of Boston, is chairman.

Mr. Mason: Mr. President, I request that the Secretary read the report of the committee. I respectfully present the report which is in his hands. The secretary, has, I think, 200 copies of this report printed and

(*Continued on page 7.*)

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The Telephone Convention now in session promises to be as successful as even the Electric Light Convention. There is a big attendance, and good work will be done.

President Duncan and Executive Committee Chairman Moses, should feel proud of the Convention given under their official management. In influence, character and attendance, it carries off the honors over all predecessors.

The increase of invested capital in electrical distribution companies in this country during the past six months has been prodigious, and indicates a prosperity of the manufacturing companies which must make glad the hearts of their stockholders.

Last week it was electric light and power; this week we have the telephone and its earnest advocates. You are heartily welcome, Sir Knights of the Far-Talker, and the REVIEW shall be pleased to see each and every one of you, and wishes you a pleasant and profitable sojourn in the metropolis.

The electric light men from other cities, who have been hounded by ignorant legislation and demagogue officials, could scarcely believe their ears when they listened to the sensible words of Mayor Hewitt. And they all knew that he was right and just, and it filled their hearts with great joy to find one man in prominent political life not afraid to speak the truth, and abundantly able to defend his position against all comers. Mayor Hewitt, the REVIEW salutes you, and unites with every electrical man in wishing you many more happy years of life.

The Hotel Brunswick is undoubtedly the best arranged and best located hotel in New York for such Conventions, and Dr. Moses acted wisely in making this selection. Its magnificent banquet hall made the finest and most comfortable convention room ever enjoyed by the electric light men, and the adjoining parlors used for general reception and committee rooms, were particularly convenient. In this great city of New York, where every inch of floor space is so valuable that small rooms are always in order, the spacious rooms of the Brunswick are especially desirable.

THE EIGHTH CONVENTION.

Another Convention of the National Electric Light Association has met and adjourned, and the meeting like each of its predecessors has added greatly to the credit of the founders, and reflected honor on the present members. It was the most successful meeting yet held by the Association, and these meetings are getting to be closely watched by the workers and students in electricity everywhere. The proceedings are of great benefit not alone to those directly interested, but also to the general public; they serve to educate the masses, destroy superstition, and calm the popular, but groundless fears of the new force.

These Conventions are the milestones of progress in the grand onward march of civilization, and they show us most forcibly that we have gone so far on the highway of improvement that we can never return to the gloomy regions of ignorance—and we do not want to.

It has come to pass that from all parts of the country the Semi-annual Convention is attended by men of scientific culture, men of experience in the practical development of electricity, men of sound business train- and judgement; and when they speak out plainly and fearlessly on any subject their voice is heard, and its influence felt in all parts of the globe.

The statistics gathered by the able President of the Association, show a wonderful increase in plants for the distribution of electric light and power, and the moneyed interests involved therein.

Taking these statistics of the past ten years, it is clear that the progress of electric lighting, or comprehensively, the distribution of electrical energy, has been incomparably swifter than that of the steam engine or any of the great inventions or discoveries of any age. The amount invested is colossal in proportions, and some of the best business talent in the country is proud to be connected with these interests.

The papers read at the last meeting were of special interest, and all were on practical and every-day, but important subjects, and much information was imported to the delegates thereby.

Mayor Hewitt sounded the keynote of common sense in his very able welcoming address, and we predict a change of attitude by the interested public on the question of undergrounding the arc-light wires. The Mayor is to be congratulated. The paper and discussion on fuel shows that the members are keenly alive to the economical production of electrical energy, and are not producing for amusement. Mr. Wheeler's paper on the overhead and underground wires in New York conveyed much very interesting information.

One of the most important papers, because of its practical outcome, was that of Mr. Acheson, which shows how a persistent search for the cause of a defect will always end in the contriving of a preventative; and his device for preventing cable punctures is as effective as it is simple.

Prof. Van der Weyde cleared up some fog in the popular mind by explaining technicalities in a popular way.

Dr. Liebig's paper on methods of electrical measurement was honored with profound attention, as it deserved to be, and should prevent many blunders which are frequently made even by those who deem themselves experts.

Mr. Week's paper on Electrical Education was full of suggestions which will bear fruit in the coming development of scientific education of the masses.

Mr. Lufkin imparted many practical hints to power companies.

We publish the proceedings, and we commend them to our readers' careful perusal. Everyone will find something which will repay him for the reading.

Mr. Acheson's proposed system of protection against the pin-holing of cable coverings seems to meet an exigency which has of late been proving troublesome and very annoying.

At the Electric Club.

TESTIMONALS PRESENTED TO EX-PRESIDENT MORRISON AND GEO. WESTINGHOUSE, JR.

The Electric Light Association upon adjournment from the Hotel Brunswick, Friday afternoon, was called to order at the Electric Club at 3 o'clock by President S. A. Duncan. Several of the wives of the delegates were present.

Dr. Moses then said:

It has been my pleasant duty to be the depository of a secret. It has been the desire of numerous friends of our honored first President of this Association to exhibit to him something that he might recollect. This time they have managed, I think, to embody something that will suggest to him in some way the esteem that they have for him by giving him something new every time that he looks at it. There is crystallized in this box all the good feeling, appreciation and good fellowship that has actuated every member of the Association towards Frank Morrison. We have tried to embody in this, his life, and there is symbolically typified upon it something representative of the different phrases of his active existence. In the first place we have started with the idea that it should be simple and strong; we have tried to paint this thing in black and white, and we hope that he will read between the lines in it all the good feelings that we have for him.

At the risk of being a little prolix, I will explain the designs here which represent a good deal of hard work on the part of the principal men at Tiffany & Co.'s, who entered into it *con amore*, I assure you. We see on a very simple base a silver box having inscribed upon it this: "Presented to J. Frank Morrison by his friends of the National Electric Light Association, New York, August 31st, 1888." On this base we have three barriettes; one represented a continuous current machine, the center one an alternating current machine, and the third a machine for the distribution of electric force. The first one is a Brush machine, and I think in the hands of Frank Morrison it did as much as it did anything else to establish the fact that electricity could be distributed from central stations profitably. In the center we have a machine that was brought to the notice of the Association at a time when he presided over it. Third and last, but not least, there is a Baxter motor. Mr. Morrison represents the Baxter motor as head front. All around you will find the Baxter motor worked up like a Greek honeysuckle. It makes a very beautiful decoration; so that the base of this is Baxter motor. On the faces of this you will see "Baltimore," whence Mr. Morrison comes, "New York" where he receives this token, and on these sides are represented the places where all our Conventions have been held—"Baltimore, New York, Chicago, Detroit, Boston, Philadelphia, Pittsburgh."

By the bye I must turn off the switch here in order to get at the key that was introduced to typify in some way Mr. Morrison's connection with telegraphy, and through all the various progress by which he has reached the position of being the first president of the National Electric Light Association.

Here, sir, is an insignia of office that you have wielded so successfully at the head of all our conventions—the gavel. The National Electric Light Association, I think, more than to anyone else, owes its existence and successful development to you. It was by means of that little instrument, a symbol of power seldom used except for good that we would typify you with. We have been ruled by it, and we have frequently kissed the hand that bore the rod. Upon this is an inscription: "J. Frank Morrison, 1885–1888; First President National Electric Light Association." Here is something typical of an electric cable in order that you may with this in your hand hear yourself in contact with every one whom this is intended to govern. This is an insulator. The president must be insulated from all the influences that prevail on the floor of the assembly. (Applause). And we thought that to have been the best symbol that we could put upon the gavel. (Applause.)

Mr. Morrison: Mr. President, ladies and gentlemen: They say that the most trying time to the soldier is when he is under fire and cannot shoot back. I take it for granted that those of you who have been brought suddenly into a position of this kind can have some little sympathy with the soldier. The fire of compliments that I have received for the last 15 minutes is enough to break the nerve of a man of much more self possession than I. In discharging the duties devolving upon presidents of the Electric Light Association, I have not always been able to do that which would, as Dr. Moses suggests, make them wish to kiss the hand that wielded the rod. I think they felt more like having that rod themselves a little while sometimes. But a man can discharge a disagreeable duty honestly, and will at the end of it get from all fair minded men that reward which is almost better than anything else—fair treatment in return. The criticisms or the acts of men who are not fairminded are not worth anything, and therefore we won't consider them at all. My connection with the National Electric Light Association has been a very pleasant one. It has been a sort of channel through which I have made friends in every part of the country. It makes no difference whether I am in Maine or Texas, I find members of the National Electric Light Association—that organization which was born less than four years ago, I find friends spread out all over the country and in every case extending a hearty greeting and a hand of friendship. In that way I feel amply repaid for all the troubles that fall to the lot of a presiding officer. It has made the labor of the President of the National Electrical Light Association, a labor of love.

My position is a most embarrassing one which, in the future, if I am on a committee, and I have the honor of presenting to the retiring president of the association a testimonial, I pledge my word of honor I will never place him in. I thank you for your courtesy; I thank you for the kindness you have shown me along this journey of electrical—what do you call it—

Mr. DeCamp: Tribulations.

Mr. Morrison: Electrical tribulations. Thanks, Mr. DeCamp. I thank you for all the kindness you have shown to me during all these years. It is not necessary for me to tell you that I will remember it as long as I live, for I could not possibly forget it if I tried, and I would not if I could.

Before I step back, I want again to call your attention to the remark I made a moment ago. Within the next 24 months will be determined the question whether the National Electric Light Association will become a permanent institution or whether it will pass away as thousands of other associations have passed away, leaving hardly a trace. This to-day is the strongest electrical organization ever gotten up in this country. It is not strong in members, but it is strong in its firmness of purpose, and it is strong in the honesty of its members up to the present time who, I am happy to say, have been able to eliminate every feeling of personal advantage, and have met upon a common footing. Now, with that feeling, I say guard yourselves against suspicion, against jealousy, and whenever a question comes up which you will be called upon to decide, think first not what will this do for me; you gentlemen of New York, do not stop to think what it will do for the New York Electric Club. You, who are engaged in the wire business, do not say what will this to do the advantage of my business. But knowing and feeling that neither social organization nor private business can be advanced or live unless you act on the basis of fairness and honesty, and when those questions come up, give and take until you get a synchronism along the whole line.

This is the first chance of my life I have had a talking before ladies. I have only fear of one (laughter), and she, like the poor spoken of in the Gospel, I always have with me. One of the difficulties that a man untrained in speaking is the difficulty not what to say, but where to stop. I never have been able to find that point, and so have to break off just as abruptly as I do now. Gentlemen, I thank you. (Applause.)

Dr. Moses: There is one other very pleasant duty that has been thrust upon me like greatness upon many men, and if Mr. Byllesby is here, the representative of one of the Westinghouse interests, who contributed so pleasantly last spring to entertain us while in Pittsburgh, I would be glad to say to him what I have to say.

This, gentlemen, is a little testimonial from the Association. I will not say a receipt in full, but a receipt on account of the National Electric Light Association for many kindnesses extended by the interests represented by Mr. George Westinghouse. The inscription, however, I think will convey in a very few words, just exactly what was intended to be conveyed: "George Westinghouse, Jr.: From the National Electric Light Association, in grateful recognition of numerous attentions and substantial favors extended by his various companies during the Pittsburgh Convention, February 21st, 22d and 23d, 1888. Presented New York, August 31st, 1888." I would like to recall to your recollection that Mr. Westinghouse's companies in a very delicate way sent us quite a number of checks, which amounted in the aggregate to some $1,100 or $1,200, which were accompanied by the express wish that the subscription might contribute in some way to the publication of the valuable proceedings of this Association. The best return we can make for the field given to us is to present the donor with the fruits which it produces, and we have here a copy of our transactions bound, in, I hope, an appropriate way to convey at least our delicate sentiments to him.

On motion the Convention adjourned, and a number of the delegates, including the officers of the Association, were photographed on the steps of the Club House.

The Electric Light Convention Exhibits.

Among the exhibits were the following:

American Electrical Works, Providence, R. I., showing lines of insulated wire. They report business excellent all around.

American Waltham Watch Company, had a fine display of their non-magnetizable movements. A very ingenious devise caused an old and new style watch movement to be successively brought into the field of a steel magnet and allowed to remain a few seconds. The old style stopped every time, while the new movement beat away as if there were no such things as magnets.

Anti-Magnetic Shield and Watch-Case Company of Chicago, had a very affable gentleman showing a handsome line of their goods.

Baxter Electric Motor Company exhibited a set of photos of the practical installations of their motors.

Bernstein Electric Light Manufactuing Company of Boston, had one of their lamps on exhibition.

Callender Insulating & Waterproofing Co., of New York, showed an extensive line of samples. They report business very brisk. They have just closed an extensive contract at Minneapolis for their "solid" system of underground cables.

Campbell Electrical Supply Company, Boston, showed a line of samples, and report business as being tip-top.

Central Electric Company of Chicago were represented in the double parlor held by the Okonite Company.

Eddy Electric Manufacturing Company of Hartford and Windsor, Conn., were represented by Secretary A. D. Newton, whose broad smiles told a tale of prosperity and anticipation of more to come. They also exhibited their new specialty the "Heath Self-Timing and Recording Speed Counter." Every station and machine shop should have one of these instruments.

Electrical Accumulator Company of New York, had a complete display of their storage cells and appliances for charging and discharging.

Electro Dynamic Company of Philadelphia had some samples of their excellent work in installation devices.

Elektron Manufacturing Company of Brooklyn exhibited their specialty, the Barrett Chloride of Silver Test Battery and Physicians sets. Their business is fast growing to enormous proportions.

E. S. Greeley & Co., of New York, had a large display of the extensive lines of goods manufactured and furnished by them. They seem to keep everything. Frank Magee was their general representative.

Empire City Electric Company was represented by their jolly secretary, Mr. E. W. Carritt, but did not exhibit any goods.

E. P. Gleason M'f'g Co. had a pretty display of the fixtures and shades, etc., which are made a special department by this firm. They report business very good.

Government Waterproof Paint Co. showed some samples.

Grove Electric Meter Co., of Philadelphia, exhibited the latest form of their ingenious device.

Gibson Storage Battery Co. showed their battery in operation with a few small power lamps very tastily arranged.

Gassner's Dry Battery attracted much attention. It promises well.

Hurlbut Flexible Conduit Co. had a section of conduit on view.

Hartford Dynamic Co., Hartford, Conn., Incandescent Switches, etc.

N. Y. Insulated Wire Co., J. W. Godfrey, General Manager, had a large line of samples, and report business booming, especially in their new "Competition Line Wire."

National Conduit M'f'g Co. Wrought Iron Cement Lined Pipe for subways.

Novelty Electric Co., Philadelphia. Represented by Mr. C. E. Trump.

Non-Magnetic Watch Co., of America, displayed a line of their watches fitted with Paillard's patent non-magnetic hair spring and balance wheel.

The Okonite Co. had the most extensive and best arranged exhibit of insulated wires and cables. Some beautiful samples were shown of lamp cords, single and double, and all sizes. Also line wire, ærial, underground and armored submarine cables of all styles. They report business as being almost too much for them, notwithstanding the exceptional facilities they enjoy.

Phœnix Glass Co., of Pittsburgh, made a hadsome showing of the beautiful specialties in globes and shades for which they have built up a well deserved reputation.

F. E. Pettingill & Co., of Boston, showed a line of tools especially adapted for linemen and machinists in electrical construction.

Jas. W. Queen & Co., of Philadelphia, had an extensive instrument display. This firm are agents in this country for Ayrton & Perry, Hartmann & Braun, Elliott Bros., and other celebrated foreign makers.

Sawyer-Man Electric Co.'s headquarters had a magnificent display of all styles and sizes of their lamps, switches, safety plugs and other appliances of their own manufacture, all in operation or use, besides an elaborate line of samples of the same open for inspection. The simplicity of the devices and the character of workmanship elicited favorable comment on all sides.

The Simplex Electrical Company of Boston showed a line of insulated wire and cables in their specialty, and report business splendid. Have doubled the capacity of their works lately and still find themselves behind their orders.

Chas. A. Schieren & Co., showed a new style of leather belting, which they call the "Patent Perforated," which prevents air cushioning between belt and pulley and effects a closer contact and better grip.

Standard Underground Cable Company of Pittsburgh, had a fine display of the admirable line of lead-covered wires and cables made by them. After Mr. Acheson's able paper, their rooms were visited by everybody.

Standard Paint Company had some interesting samples of the work accomplished by their compound.

The Standard Electrical Works, of Cincinnati, were ably represented by Mr. E. V. Cherry, though no exhibit was made.

The Sprague Motor Company's headquarters were much frequented for information as to railway work. They exhibited one motor with their new self-oiling journal box attachment, and a number of maps and photographs descriptive of the various applications of their system.

The Thomson Electric Welding Company, of Boston, had a very complete display of the almost innumerable applications of their electrosmithing process. There is a great future before this company, and they are preparing for it. Already the demand for their apparatus is widespread, and those who have used it speak of it in the highest terms. It does welding which never before could be done by any process or skill.

The Western Electric Company did not exhibit any apparatus, but had able representatives in Col. Beetle and Messrs. Brown, Thayer, Harrington, Wilkins, Salt, and others. The long distance telephone in their room was a great accommodation to the delegates, and was duly appreciated.

The E. P. Gleason Manufacturing Company, of New York, had on exhibition, in parlor 15, many artistic samples of fixtures for incandescent lighting; also a large assortment of staple appliances, such as insulated joints, sliding canopies, tin shades, wire guards, brackets, rich cut and art glass for arc and incandescent lighting. A feature of the exhibit was an incandescent street lamp, a weatherproof device for street lighting by incandescent, novel in design, practical in use, and furnished complete at a very low cost. Wm. F. Cullen represented the above company at the Convention.

The extensive platinum works of Baker & Company, Newark, were represented by Mr. Cyrus O. Baker, Jr., who possesses a wide circle of friends as well as customers in the electrical field.

Exhibits at the Telephone Convention.

The Western Electric Company had a large exhibit in parlor 3. It included long distance metallic circuit apparatus, testing apparatus, the new magneto bell with platinum contacts and noiseless gear, and a number of samples of the Patterson cable. This parlor was quite a point of attraction for the practical telephone men.

The Okonite Company occupied the same parlors they had at the Electric Light Convention and presented the same fine exhibit, including the graphophone which was seen for the first time by a number of telephonists.

Mr. F. E. Degenhart had samples of underground cable in one of the parlors, where also were to be seen Law batteries.

The American Bell Telephone Company had the large parlor 4 for its reception room, where were exhibited those well known telephone hustlers, T. B. Doolittle, Frank B. Knight, Major J. M. Brown, and others. This was the parlor occupied by the REVIEW last week and is well adapted for a general reception room.

The National Conduit Manufacturing Compahy has a handsome exhibit of their conduit joints and sections in one of the parlors.

The H. B. Cox Manufacturing Company of New Haven, had a number of gelatine batteries on exhibition.

Every member was presented with a brass badge by the secretary. It was in the form of a telephone receiver.

The New York daily press was particularly successful in giving comprehensive and interesting reports. The bright young men who represented the dailies are to be congratulated over the admirable manner in which they handled the very difficult discussions and papers of this technical, practical organization.

Clams and Electricians.

THE ANNUAL CLAM BAKE OF THE AMERICAN ELECTRICAL WORKS AT PROVIDENCE SCORES ITS TENTH GREAT SUCCESS.

The clams of Rhode Island are the only citizens of that State who are suspicious of Eugene Phillips and his capable associate, W. H. Sawyer. And every one of the 230 electrical men who enjoyed the clam dinner provided by these gentlemen last Saturday would made good witnesses on the side of the unfortunate, but nutritious clams. For ten years these dinners have been a memorable event in the minds of the electrical fraternity, and the only ones who desire to see them fall on a rainy day or fall into "innocuous desuetude" are the aforesaid Messrs. R. I. Clams. But good fortune very properly is with President Phillips and his American Electrical Works, and the tenth bake proved no exception to the rule in point of fine weather and enthusiastic and numerous clam appetites.

A steamer, the "Catskill," under command of Chairman C. H. Barney, had been chartered to carry over the New York party, including the members of the National Electric Light Association who were expected to attend, and a large and particularly lively delegation boarded her Friday evening and sailed out of the New York harbor about 6 o'clock with colors flying and music playing, a band being specially chartered for the occasion. The water ride was a great event, and the fun that was had aboard that vessel would take a volume to tell—and that just at a time when every line of space in this journal is doubly precious. About 2 A. M., however, sweet peace came and lingered for nearly 30 minutes and tired ones felt that now they could sleep. Not so. The immense dinner gong was suddenly resurrected, likewise the bass drum, and several horns, and such a noise as all at once burst upon the horrified ears of the sleepers was never heard on Long Island Sound before. It penetrated every corner, in two instances shattered glass doors, and turned men grey who had trapped lions in Africa without turning a hair. Fred Washington Royce, with his strong right arm wielding a baton on that gong; Alexander Hamilton Patterson pounding on the bass drum, and several horn blowers, including Frank Ridlon, with breaths of paralyzing strength, comprised a procession that serenaded every stateroom from bow to stern. No one had cause to feel neglected.

But with all the boat finally arrived at Providence, somewhat late, owing to a heavy fog. Some of the passengers, to make sure of being on time, took the train at New London and Stonington, and by 2 o'clock all were at Veu de L'eau Club hungry for clams, and they feasted to their heart's content.

Governor Taft, of Rhode Island, welcomed the visitors to the bake which was given in a large tent, and a number of toasts were responded to by gentlemen unexpectedly called on by toastmaster C. M. Ransom. On behalf of the New York delegation Mr. Henry C. Davis presented to Mr. Phillips and Mr. Sawyer, for their wives, two very elegant cut glass sets, completely surprising these gentlemen. On their behalf ex-Governor Howard eloquently thanked the donors, and took occasion, while speaking, to give expression to high compliments of the electrical press and also the daily press for what they had done and were doing for the cause of electrical science. Beautiful bouquets adorned the tables, the gift of John I. Sabin.

Games with foot and base ball concluded the day, every visitor carrying away with him a beautiful poetical menu gotten up in book form.

Sunday morning the "Catskill" carried the party to Newport, the ride down the Narragansett bay being hugely enjoyed. At Newport Col. Henry Buell, of the Telephone Company, and the Edison and Newport Electric Lighting Companies gave the visitors a ten-mile ride over the city and the ocean drive, and later a visit to the U. S. Torpedo Station was enjoyed, the officers receiving the visitors with every courtesy. Lieutenant-Commander G. A. Converse, and Paymaster F. H. Clark did the honors and made the visit a memorable one. Chemist Chas. E. Munroe greatly interested all the visitors with his description of high explosives and their effects. We hope to be able to describe the station at more length.

Mayor Hewitt's admirable address to the Electric Light Convention gives evidence of a profounder study of the general progress of the world than the statesman is usually given credit for. Speaking about accidents due to the electric current, he aptly said: "I "found that with all the difficulties of this "thing, the results seemed to show that it "was absolutely safer than any other useful "agency at work in this city," and he was correct, as usual. All this fuss about death in the wires is mere buncomb. Somebody has a basket of eggs looking for a market, and cries poison in the meat, bread and vegetables, and nothing is wholesome but eggs. But it is all sham.

THE TELEPHONE MEN.

(Continued from page 1.)

Exchange Association being admitted. This session consumed all the afternoon, until 5 o'clock, and much discussion was indulged in relating to the future policy of the Association. There was no action, however, all motions being laid on the table.

WEDNESDAY'S PROGRAMME.

Convention at 10 A.M., continues till 2.30 P.M.

"Dynamo Current Interferences with Telephone Circuits and Means of Relief," is the title of the first paper, presented by C. E. McCleur, of Richmond, Va.

"The Electrical Relations of Telephone and Electric Light and Power Circuits and Railways," by T. D. Lockwood, of the American Bell Telephone Co. These two discussions together.

"Underground Work in Brooklyn," by W. D. Sargent, of Brooklyn, Mr. Beckwith, of the Metropolitan Telephone and Telegraph Company, will read a short account of the Underground work in New York City.

"Telephone Exchanges of New York City," by E. F. Sherwood, of the Metropolitan Company.

"The Telephone," by Dr. S. M. Plush, of Philadelphia.

"An Important Judicial Decision—Telephone Companies *vs.* House Movers," by H. G. McCully, of Jersey City.

"Statistical Report," by Secretary C. H. Barney.

At 3 P. M., the Association takes the drive announced above, with the American Telephone & Telegraph Company, and after viewing the splendid construction of this company's long-distance lines, will dine at Mt. St. Vincent, as the guests of the Western Electric Company, dinner being announced for 7 o'clock.

The programme of Thursday will consist of the all-day excursion so generously tendered by the Metropolitan Telephone & Telegraph Company of New York, the president of which company, Mr. Theo. N. Vail, is so widely and favorably known in the telephone circles of the world.

THE ATTENDANCE.

The following delegates to the telephone convention have reported:

P. C. Ackerman, New York, Am. Electrical Works.
Geo. Albree, Omaha, Am. Bell Teleph. Co.
P. H. Alexander, Boston.
L. W. Burnham, Boston, The El. Gas Lighting Co.
C. H. Barney, Sec. of the Association, New York.
F. J. Boynton, N. E. Teleph. & Tel. Co., Boston.
J. M. Brown, Washington, Am. Bell Teleph. Co.
R. M. Bailey, Williamsport, Pa., Cen. Pa. Teleph. Co.
Saml. Bryan, Washington, Ches. & Poto. Teleph. Co.
F. Attwater Barnes, New Haven, Ct., H. B. Cox El. Co.
A. D. Bullock, Cincinnati Teleph. Co.
Leonard F. Beckwith, New York, Met. Teleph. Co.
Cyrus O. Baker, Jr., Newark, Baker & Co. (Platinum.)
W. H. Cull, Albany, Hudson River Teleph. Co.
Willard L. Candee and Geo. T. Manson, New York, Okonite Co.
Joel C. Clark, Morristown, N.Y. & N. J. Teleph. Co.
E. V. Cherry, Cincinnati, Standard Electrical Wks.
W. J. Cole, Atlanta, So. Bell Telephone Co.
D. I. Carson, New York, So. Bell Telephone Co.
Thos. B. Doolittle, Am. Bell Telephone Co., Boston.
Geo. F. Durant, Bell Teleph. Co. of Mo., St. Louis.
Flemon Drake, Omaha, Neb., Nebraska Teleph. Co.
F. E. Degenhart, Chicago, Stand. Und. Cable Co.
W. J. Denver, Boston, N. E. Teleph. & Tel. Co.
Henry C. Davis, New York, Pres. Electric Club.
J. R. Dee, Houghton, Michigan Teleph. Co.
Chas. Dutton, New York, So. Bell Telephone Co.
W. N. Eastabrook, Elmira, N. Y. & Pa. Teleph. Co.
W. H. Eckert, New York, Met. Teleph. & Tel. Co.
John D. Easterlin, Charleston, So. Bell Telephone Co.
E. B. Field, Denver, Col., Colorado Teleph. Co.
C. J. French, Boston, Asst. Gen. Mgr. Am. Bell T. Co.
I. H. Farnham, Boston, New England Teleph. Co.
F. A. Forbes, Detroit, Michigan Teleph. Co.
J. J. Fowler, New Orleans, Great So. Telephone Co.
H. N. Gifford, James Clark, J. B. Speed, Ohio Valley Teleph. Co., Louisville, Ky.
J. W. Godfrey, N. Y. Insulated Wire Co.
W. A. Hovey, T. D. Lockwood, A. O. Morgan, Am. Bell Teleph. Co., Boston.
F. J. Hovey, N. Y. Am. Teleph. & Tel. Co.
Edwd. J. Hall, Jr., New York, Gen. Mgr. Am. Teleph. & Tel. Co.
A. S. Hibbard, New York, Am. Teleph. & Tel. Co.
M. M. Hayden, New York, Law Teleph. Co.
Samuel Ivers, New Bedford, Mass., So. Mass. T. Co.
J. M. Jackson, Chicago, Treas. Western Electric Co.
F. W. Jones, New York, West Coast Telephone Co.
Frank B. Knight, Texas, Am. Bell Teleph. Co.
A. A. Knudson, St. John, N. B., New Brun'ck T. Co.
J. F. Kelley, New York, Edison Machine Works.
N. W. Lillie, Boston, N. E. Teleph. Co.
Henry Metzger, Pres. of the Association, Central District & Printing Telegraph Co., Pittsburgh.
E. G. Main, Secretary's Assistant, Brooklyn, N. Y.
Chas. W. McDaniel, Kansas City, M. & K. Teleph. Co.
T. C. Martin, New York.
J. E. McConnell, New Haven, Ct., H. B. Cox El. Co.
J. P. McQuaide, New York, National Conduit Co.
E. W. McCleur, Richmond, South. Bell Teleph. Co.
O. E. Madden, New York, Empire City Electric Co.
F. A. Magee, New York, The E. S. Greeley & Co.
C. A. Nicholson, Utica, Cent. N. Y. Teleph. Co.
F. A. Pickernell, Am. Teleph. & Tel. Co., New York.
R. W. Pope, New York.
David B. Parker, New York, Am. Bell Teleph. Co.
E. S. Perot, New York, National Conduit Co.
J. C. Reilly, Brooklyn, N. Y. & N. J. Teleph. Co.
C. F. Sise and H. S. Thornberry, Montreal, Canada, Bell Teleph. Co. of Canada.
T. T. Smythe, New York, Washburn & Moen.
H. L. Storke, New York, Empire State Teleph. Co.
C. E. Scribner, Chicago, Western Electric Co.
W. D. Sargent, Brooklyn, N.Y., N. Y. & N. J. T. Co.
J. A. Seeley, New York, Met. Teleph. & Tel. Co.
Henry D. Stanley, Bridgeport, Brass Co.
H. B. Thayer, C. A. Brown, Geo. L. Beetle, J. J. Carty, F. W. Harrington, A. L. Salt, Western Electric Company, New York and Chicago.
W. A. Vail, New York, Met. Teleph. Co.
Theo. N. Vail, N. Y., Prest. Met. Telph. & Tel. Co.
George Worthington and Chas. W. Price, ELECTRICAL REVIEW, New York.
F. G. Wood, Utica, Cent. N. Y. Teleph. Co.
A. C. White, Providence, Providence Teleph. Co.

Telephonic News

*** The Postal Telegraph-Cable Company has opened a new line to Portland, Me., and intermediate points.

*** It is stated that the Southern New England Telephone Company are soon to begin renewing their lines. The average life of telephone wires is from five to eight years.

*** The San Diego, Cal., trustees have directed the city clerk to advertise for bids for a fire alarm system. The Gamewell system has been recommended by the fire committee.

*** The Chicago Telephone Company is laying a submarine cable across the Calumet river at Ninety-fifth street, the intention being to supply East South Chicago with a telephone service.

*** A new telephone cable is being constructed for the line between San Francisco and Sacramento. The present cable between San Francisco and Oakland has been damaged and spliced in several places.

*** Telegraphic and telephonic communication have been established between Susanville, Lassen county, Cal., and the terminus of the Western Union Telegraph Company's line at Greenville. This new line is fifty miles in length, and has been built by E. R. Dodge, W. H. Hall and N. S. McKinzey of Susanville, and A. R. Bidwell of Greenville.

*** A new cable has been ordered by the Sunset Telephone-Telegraph Company, which will be laid between Oakland and San Francisco. The cable will cost $30,000 in all. As there has been found so much trouble from induction on the land portion of the circuit to San Francisco, the wires on the mole will be so arranged that they will not be affected by the telegraph or electric light currents of high tension.

*** The American Bell Telephone Co., which has bought the four buildings on the corner of Milk and Oliver streets, Boston, intends to build a fine substantial building on their site. The building will be designed for offices. It is expected that the old buildings will be torn down by November 1st, ready to lay the foundation. The occupants of the old structures are ordered to vacate by October 1st, and with one exception they will all be out by the middle of September.

*** The Chesapeake and Potomae Telephone Company are the first to respond to public sentiment, says the Washington *Star*. They have petitioned the commissioners to allow them permission to change their overhead system to underground conduits. The matter was referred to Capt. Symons for his opinion. In his comment upon the subject, he recommends that the permit be issued. The telephone company intends, if permitted, to lay 27,000 feet of underground cable. It is understood that the necessary permit will be issued in a few days.

*** A short time since, the Southern New England Telephone Co. made a verbal agreement with the Willimantic Electric Light Company, allowing the latter to string its wires upon the telephone company's poles, with leave to remain if the electric current did not interfere with telephonic work. Late Saturday night the telephone company gave verbal notice to the electric light company to remove its wires. The order was issued so late that they did nothing about it. On Sunday night a gang of men were landed from New Haven by order of the superintendent of the telephone company, and immediately went to work and cut down a mile of electric wire, cutting it twice between each pair of poles, thus destroying a large quantity of the wire. It is reported that a suit will be brought by the electric company.—*Ansonia, Conn., Sentinel*

A MAGNIFICENT HOSPITALITY.

THE ENTERTAINMENT PROVIDED FOR THE NATIONAL ELECTRIC LIGHT ASSOCIATION BY THE OKONITE COMPANY.

The Okonite Company, and Messrs. Cheever, Candee and Manson, have covered themselves with highest honors. With unstinted hand and most intelligent management they entertained the entire Electric Light Convention, attendance to the number of 290, at the new and electrically lighted "Broadway" Theatre, Thursday evening, at which time the opera of "The Queen's Mate" was most acceptably presented. Invitations, which informed the recipients that the merits of the opera would be discussed at the Electric Club after the performance, were distributed and particular pains taken to see that all were included. And all were present and the opera delighted every one. The actors did not neglect the electrical fraternity and many names familiar to the listeners were made use of in the play, and recognized with prompt applause. The following was one of the conundrums that the audience greeted with shouts of laughter and applause.

"Why are these electricians like Okonite insulation?

"What is that? Why are the electricians' heads like cocoanuts?"

"No, no. Why are these electricians like Okonite insulation?"

"Oh! I see—because they are tough?"

No, not that. It is because water don't affect them."

The electrical audience remained to explore the stage after the performance and note the lighting effects and the arrangement of the Edison plant. The romantic battlements so recently occupied by the Amazonian Silver army were soon covered with more substantially, if less gaudily, attired electricians. The intricate system of switchboards, resistance coils, etc., probably the most complete in any theatre, was thoroughly examined and its workings explained by the obliging chief engineer. The statement that "though there were no flies on the performance, there were girls in the flies" made a momentary disturbance but order was soon restored.

The boxes were occupied by those delegates who were present with their wifes, including Mr. and Mrs. James English, Mr. and Mrs. A. V. Garratt, Mr. and Mrs. S. A. Duncan, Mr. and Mrs. H. B. Thayer. Mr. C. J. Field the chief engineer of the Edison Company who installed the electric light plant in the opera house, was present with his wife in one of the boxes.

About 11:30 the delegates arrived at the club house and were treated to an elaborate lunch that gave another token of the famous hospitality of the Okonite Company, and caused toast after toast to be given to the hosts of the evening. Kindly speeches were made by Mr. Arthur Steuart, Dr. A. F Mason, Mr. S. A. Duncan, Mr. Henry C. Davis, Dr. O. A. Moses, Dr. A. V. Garratt, and many others, each vieing with the other in expressing their appreciation of the attention received at the hands of the Okonite people. These were responded to gracefully and modestly by President Chas. A. Cheever and Treasurer Willard L. Candee of the company. The guests remained until a late hour, Mr. Wm. S. Hine adding to the entertainment in the parlors with several fine songs, while Dr. Liebig and Geo. M. Phelps artistically rendered a number of piano selections.

The entertainment throughout was a great success, and reflects the utmost credit on the generous hosts, who will ever be pleasantly remembered by all the visitors to the New York Convention.

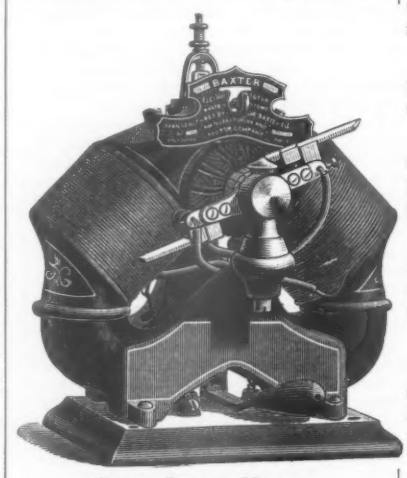
It is reported that there is to be established next spring an electric railway between Watertown and Waltham, Mass. It is proposed to build three miles of track, and the cost is estimated at about $40,000.

Frank S. Pond, Woonsocket, R. I., general superintendent of the Electric Machine and Power company's works, has received a lucrative offer to go to the isthmus of Panama to superintend an electric station there, but has not yet decided to accept.

The Baxter One-Quarter Horse-Power Motor.

The Baxter Electric Motor Company has recently placed upon the market a one-quarter horse-power constant current motor to supply the demand for a low power motor such as is suitable for certain classes of work. The field of a small motor is, perhaps, limited, the motor most generally finding its application in the driving of ventilating fans, small pumps, organs, and similar spheres of usefulness where the load is constant and automatic regulation is not required. Hence, no attempt is made to govern the motor by other than hand or treadle regulation.

The company realizes, however, the importance of producing a substantial and practical motor in every way qualified to meet the demand, and the same care and skill are bestowed upon this size of motor as in those of many horse-power. The shaft is of hardened steel accurately ground and



SMALL BAXTER MOTOR.

polished to guage. The bearings are self-lubricating, are bushed cast iron and mounted in substantial brass pedestals. The commutator is of exceedingly hard metal and will wear indefinitely. All parts of this motor are made interchangeable, so that any injury can be readily remedied by calling for a duplicate of the injured part. The motor, as is the case with all the Baxter motors, is characterized by the excellence of the workmanship throughout, and no pains or expense have been spared to provide a strong and durable motor capable of withstanding the test of hard labor or even abuse to which it may be subjected. It is very compact and neat in appearance, stands on a base eight inches square and weighs 50 pounds.

The Electric Motor and the Printing Press.

One of the many purposes to which the electric motor can be applied is well illustrated in the cuts on pages 7 and 9.

Cut No. 1 shows the Thomson-Houston motor operating the printing press in the office of the *Salem Daily News*, Salem, Mass.

The press is type-revolving, double cylinder, Hoe perfecting, and one of the largest in New England, outside of Boston. It was formerly operated by a ten horse power engine which showed a perceptible decrease in speed whenever the press was put on, and was unable to operate the paper dampening machine at same time, which additional work the engine was supposed to be capable of doing. The superior advantages of the Thomson-Houston electric motor over a small isolated steam plant led to its adoption, and both the machines are now operated by a ten horse power motor and without appreciable change in speed between full and light load.

The editions of the *News* are now run off in a much shorter time than formerly, and heat and dust and the noise of the engine, which was decidedly objectionable to the other occupants of the building, is entirely done away with.

Cut No. 2 shows the printing establishment of Barry & Lufkin, Salem, Mass., and illustrates one of the peculiar advantages of the electric motor, that of placing it, as in the present instance, under the paper cutter, or in some space which would otherwise be unoccupied. The motor used here is a one and one-half horse power.

Both of these motors were installed by the company's eastern agent, Mr. H. C. Spalding, and have given eminent satisfaction in every way to the users.

NEW CORPORATIONS

Omaha, Neb.—The South Omaha Electric Light Company, of Omaha; capital stock, $40,000.

Peoria, Ill.—The Royal Electric Company, of Peoria, is incorporated; capital stock, $10,000.

Omaha, Neb.—The Interstate Fire Alarm Company, of Omaha, has been incorporated; capital stock, $50,000.

Brockport, N. Y.—The Brockport Electric Light Company, of Brockport, has been incorporated; capital stock, $15,000.

El Paso, Tex.—The El Paso Light Company, of El Paso, has J. J. Gurdson and others incorporators; capital stock, $50,000.

Portland, Oregon.—Columbia Electrical Company, Portland; capital stock, $25,000. P. F. Morey, H. A. Hogue, Jas. Lotan, incorporators.

St. Paul, Minn.—The St. Paul Electric Light and Power Company, of St. Paul, has recently been incorporated with an authorized capital of $200,000.

St. Paul, Minn.—The Enos Electric Railway Company, of St. Paul, has been granted a charter to build a road from South St. Paul to St. Paul, Minn., a distance of five miles.

Electric Lighting Notes.

—— The two electric light companies of Biddeford and Saco, Me., were consolidated, Wednesday, and will hereafter be known as the Biddeford and Saco Lighting Power Company.

—— The experiment of using the electric light in the machine shop at Whitinsville, Mass., last winter proved so successful that the company is now extending it throughout the entire building.

—— The Augusta Electric Light Company have purchased both the electric light and the gas plants of Gardiner. The electric lights of Gardiner are now operated from the electric light station in Augusta.

—— The Heisler Electric Light Company, of St. Louis, Mo., has secured patents in Belgium, England and Italy for its system of lighting, and is expecting the same favor to be accorded them in Germany and Austria at an early date.

—— The Virginia Underground Conduit and Construction Company is endeavoring to secure the lighting of Washington, D. C., and is offering very low rates. The commissioners are said to be well satisfied with the work of the present company.

—— The Cambridge (Mass.) Electric Light Company is building a new plant on Albro street. The building is a brick one, 147x50 feet, with ell, 21x14, and is two stories in height. Lord Brothers have the contract for building it and the structure is well under way.

—— The Glenwood Electric Light Company, Glenwood Springs, Colorado, recently increased their electric light plant by purchasing a Brush dynamo, 65 light capacity, 2,000 candle power, with a full complement of 2,000 candle-power arc lamps. This company is now operating 125 arc lights and several hundred incandescent lights of the Brush system.

—— The Brush Electric Light Company, of Rochester, N. Y., have recently ordered a large number of arc lamps from the Brush Electric Company of Cleveland, Ohio. This Company, which is one of the best managed electric light companies in the country, use the Brush system of lighting. They are now burning 1,150 arc lights and 1,000 incandescent.

A GREAT CONVENTION.

(Continued from page 7.)

the chairman of the committee would be glad if those copies could be in the hands of the members of the Association.

The secretary read the report of the Committee on the Constitution, and it was made the general order for Thursday afternoon.

The President: The next business is the report of the Committee on Insulation and Installation of Plants. Prof. Thomson and Dr. Moses are on that committee.

Dr. Moses: Gentlemen, I appear here on behalf of the Chairman of the Committee on Insulation and Installation. Prof. Elihu Thomson being the chairman, I received the following letter from him which causes me to speak for him:

LYNN, Massachusetts, Aug. 25, 1888.

DR. OTTO A. MOSES,
Hotel Brunswick, New York.

Dear Sir:—It will be impossible for me to make any formal report of the work done by the Committee on Insulation and Installation of Plant.

If you will prepare a brief statement of what was done at the meeting and attach the enclosed schedule of data to be asked for, I think that it will be all that can be done under the circumstances. This might be presented as an informal statement of what was being undertaken by the committee, and the Association might then be called upon for the preparation or printing of a number of such blank schedules to be sent to the various electric light Companies.

The spacing in the schedule will need to be modified so as to give more room in some places and less in others for the answers to the question.

I am hoping to be able to run down the meeting, but I may not be there at the time when the report may be in order, and will therefore look to you, if present, to say what you can of the progress made.

Some time ago I sent a copy of the schedule to each member of the committee, but have thus far received but two acknowledgements.

Yours truly,
ELIHU THOMSON.

Gentlemen: I stood last year in the position of apologizing to the action of this committee and it was the most unfortunate position that I was put in, because I had been somewhat instrumental in organizing it. Everybody, however, was so much occupied with the rush and push of these matters that it was impossible to get what ought to have been obtained with the amount of talent that I was able to suggest should be put upon that committee. I was put upon it involuntarily, gentlemen. However, the committee has met. It has done work, and here you will find it embodied in a series of questions. But like a great deal of work that is contained in a very small space you will find that it does not show to any very great advantage. This schedule referred to here is for the purpose of obtaining data on the insulation of wires. There are ninety-nine questions in it. Gentlemen, I would say there were a hundred, but you know the old story. There are just ninety-nine questions and they will all be submitted to you in due time. I hope that you will all reply to them very carefully so as to give us data, or our successors data, to produce some valuable information for this Association. These questions go to the very root of the life, use, advisability of employing conductors of all kinds.

It is divided into various heads, and if you will only each of you write a small book—because to answer these questions means to write a small book to this association—we will have a library of our own that will come out of the actual experience of the members of this Association. None of the members of the committee have written papers on the subject. We have had several meetings. These questions are the result of conference on the subject. However, to-morrow on the occasion of the Underground discussion you will hear a very important paper read by the only member of the committee who did not feel himself justified in serving—that was Mr. Acheson of Pittsburgh. It was the only compliment he was able to return to the Association for the honor they had done him in electing him a member of the committee, although he was an interested party. It was a high compliment, and he shows his appreciation of it by reading a paper on the "Disruptive Discharge in Underground Currents." It was hoped by the president, in appointing this committee, that each member would take a branch in a scientific direction in the solution of this question. Mr. Acheson has set a good example. I must admit that I tried to have the committee take that general direction, but seemed forced to it from want of leisure, which brings many a man to do things that he would not otherwise do, because they were all disposed to write scientific articles, but they were compelled to embody as much as they could in these questions, throwing on you the onus of answering what you would answer.

That is the report I would offer for the chairman, who is absent. He may come in the course of the day, after I have received the brunt of all your criticisms. But I must say it is not my fault. I must say that in self-justification. So far as your position in this matter is concerned, all you have to do is to appoint another committee, if it is thought desirable to continue the subject, and step by step to gather such information as can be obtained by answering these questions. It will take a great deal of labor to collate the information which will be gained when this paper is distributed through the whole country. In closing what I have to say, I would like to call attention to a fact that is told in a little anecdote by Benjamin Franklin. He once knew a very high churchman, and a very rabid one, in the town of Boston, who had bought a cargo of Connecticut onions. He had put them in a store-house, and the first thing he knew, they began to grow, very much to his mortification, and on a falling market for onions. He called in a friend and said: "Just look at those things. They remind me of those Presbyterians, exactly; the more you damn 'em, the more they grow." Now, as to the excuses we make in this matter, the more we make them, the more they grow. Take it for the best; if we have not a very elaborate report to offer, it is because we haven't it to offer.

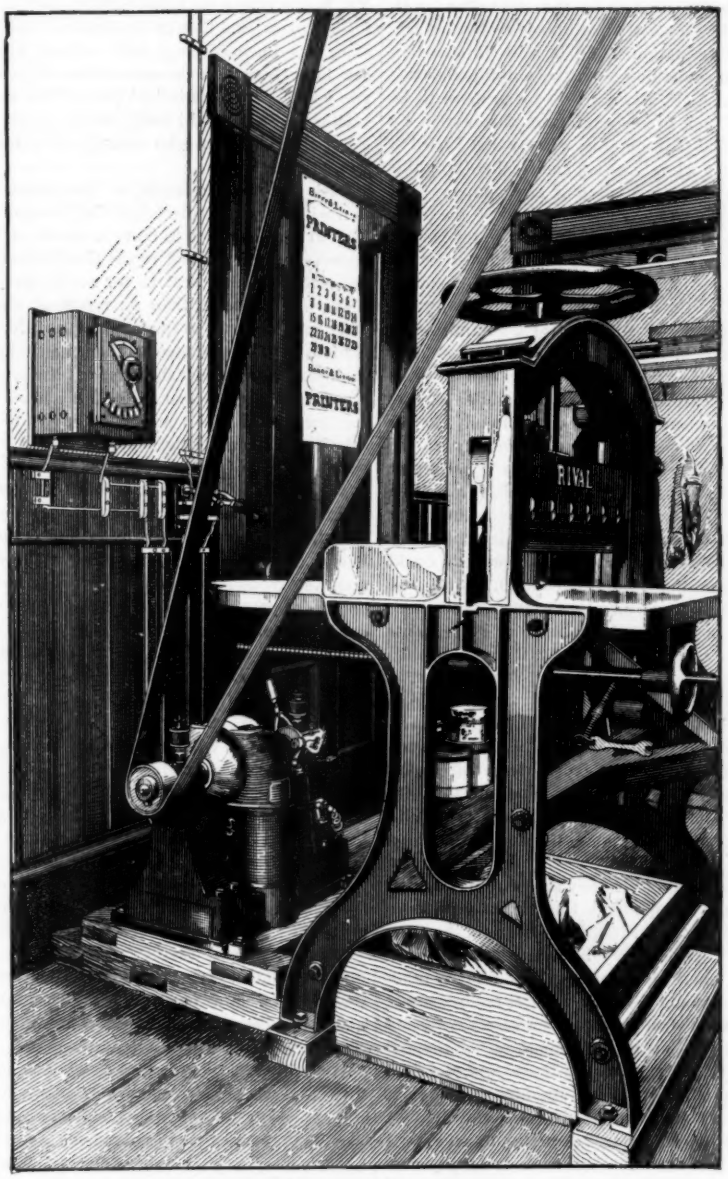


FIG. 1—PRINTING BY ELECTRICITY.

Mr. E. R. Weeks, Kansas City: I move that the report be received and filed, and the committee continue. The motion was seconded.

Mr. Morris, Nashville: I move that the report be read. Let us have something to act on. We do not know now whether we want that committee continued or not.

Dr. Moses: I have no authority to submit a report, but only to act as the mouthpiece of apology for the chairman, who is not here. His report you will have to gather as you may from his letter which I have read, The questions here, which are the results of memoranda made by all the members of the committee, I will read, if you like, but it will take a little time—about five minutes.

Dr. Moses read the schedule submitted by the committee of questions to be answered by electric light superintendents.

Mr. Morris: Mr. President, knowing that a paper on the insulation of wires was to be read, was one consideration which led me to come here, so as to learn something about that. My company has under consideration the re-insulating of its entire system, and we do not know what is the best. It seems to me that the solution of a good insulation is largely the solution of the underground question and I must confess my very great disappointment with the report of the committee on that subject. I very much appreciate the delicacy the committee would have in reporting this wire or that wire—this manufacturer's wire or that manufacturer's wire; but at the same time it is a question that ought to be taken hold of, and there ought to be some answer to that question. I think if these questions were printed and sent out, the answers that you would get would be so small in number, that they would practically be of no benefit in arriving at any proper conclusion. I am satisfied that the managers of stations are not going to take the trouble to answer those questions and practically you will have accomplished nothing. We can only receive the report and discharge the committee, and appoint a new one or continue them. But I cannot refrain from expressing my disappointment in regard to that report.

Dr. Moses: Mr. President, there is a large steam hammer at Essen that strikes a hundred ton blow. It is about twenty feet high, but the foundations of that are two hundred feet under the ground. Now although this report here looks like a few lines, there has been an immense amount of thought and discussion between us on that subject as to how to arrive at a solution of the question—that is, to make a report on insulation and installation that would be really of advantage to the National Electric Light Association. I had in view this—perhaps in innocence, because all the gentlemen connected with wire interests expressed a great willingness to co-operate with me—I wanted to have specimens of every conductor that was in use laid before this committee and to have them make all the scientific tests and to supplement those with all the time and practical tests that they could possibly devise. For that reason the president at that time selected a committee of gentlemen who had every facility in this country for doing the work. They were not prejudiced by associations with any particular manufacturing interests and each had a very excellent laboratory at his service. The Western Union was represented, the Bell Telephone Company was represented on that committee, so to say, that is, their electricians were selected as proper persons. There were other companies represented and it was thought that the results that were going to be obtained could be made very valuable in that way. We had Cornell University present by its representative. They were all willing to do a certain amount of work, they said, but they were all determined that they did not want to appear to be advertising anybody's wire. As much as to say that if the sun shone to-day and they were to praise it they were advertising the one who made it. It was true that that was all they were called upon to do—that was to report on what was good wire. I tried to carry that through but they were all too modest and fearful of the results. They then tried to throw this matter back on the Association and get what information they could right through them.

The gentleman from Nashville may perhaps be mistaken in supposing that the superintendents of the different companies will be unwilling to furnish this information. I happened to be present last evening at a dinner given in honor of the Executive Committee of this Association, for which I cannot express too frequent thanks, and there was one gentleman who is, I believe, present now who said "I waive the executive committee part of it; I speak as the superintendent of a station." Another member of the Executive Committee spoke in the same way and then another, and it seemed to me that this Association had tried rather to get superintendents of stations to represent them on the Executive Committee. Now that was a very healthful state of affairs, and why cannot we get from every man here who represents a company some information that will be of value to this Association. They are plain questions; all we want is that they should be truthfully answered, and the committee will winnow out all the chaff from it and get at some of the jewels that might be thrown broadcast, such as the Mayor spoke of.

Mr. Morrison: It strikes me the original intention was to find out—that is among the layman—to find out from the scientists who are members of the Association, what is the best material, and how it is best to apply that material to bring about the best condition of insulation for air lines namely. I do not believe any steps have been taken in that direction by any of the committees that have been appointed. The list of questions which Dr. Moses has just read, goes to show that they are on the hunt for the same kind of information we are after. We sought to get the information from them. They are coming back now to get that information from the station superintendents. I do not believe you will get that information there. I do not believe that you will get a foundation that will go far enough into the earth to prevent jarring, if you seek to build your foundation in that direction. I do believe that if the chairman of the Committee on Insulation were to press the case month by month during the recess between the meetings of the Association that he would get from the men, the use of whose laboratories we had in view when the committee was appointed, satisfactory data from practical experiments—from experiments made in lines which the superintendents of companies have not been able to reach, and such information as would put us on the right track in all future operations.

The question of how to steer clear of insulated wire seems to be the one most largely in the minds of the men who own the stock in electric light companies. I beg to call the attention of the gentlemen here who belong to the various companies throughout the United States, to this statement which I have just made, and to ask them if there are any here who will fail to corroborate that statement. If the manager of an electric light company selects a first-class insulated wire for his company, the first question is, "What will it cost?" He will state to them that it will cost so much. Why, the answer is, there is Mr. De Camp's company in Philadelphia, that buys wire for twenty-five cents a pound. The president, or one of the directors of your company will say: "Why can't you use exactly the same wire?" Well, you can, but you won't have insulated wire; you will have underwriter's wire; you will have cotton insulation, which means no insulation. Now, I claim that there are to-day half a dozen insulated wires which quite nearly fill the bill that we require. But the moment you suggest any one of those, then there arises in the mind of every member of the Association the fact that you are boosting some man's business at the expense of some other man's business. The next thing is that you are sat upon. Now, one of the evils for which I have never been able to suggest a remedy, is just this one. You want information. From whom can you get reliable information? From the man who has followed such a course of investigation as enables him to come with something in his hand and say, "Here is an article which will do so and so." That man is a wire man; he has produced some sort of an insulated wire, and he makes a broad claim for that wire. Now, it seems to me that if this committee was to take the wires offered by the gentlemen who claim such and such qualities of insulation, and apply the apparatus and the facilities which their laboratories afford to the testing of that insulation, and give a fearless and unbiased report, such an investigation, I believe, will very nearly carry out the idea which was in mind when this committee was first appointed. I throw out this suggestion for the chairman of the committee. Of course, I see the president gives me a great deal of latitude in this case.

The President: I have to everybody, sir.

Mr. Morrison: Thank you, sir. I am trying to get at the right thing, but I cannot get at it as directly as I could if it were some other thing which I know more about. Have I impressed you clearly, gentlemen of the Association? If I have not, perhaps if you will ask me a question or two on this line it will brighten up my recollection a little bit. Let me repeat what I said: If instead of the committee which has been appointed going to the superintendents of stations and asking them for the information which this association has sought—if they will take the facility which they possess and will take the material which is now upon the market—the insulated wires for which such claims are being made, and will make practical working tests of those wires and will give us the result of that, it will be more satisfactory and more in the line of what was intended when the committee was appointed. There is some sort of a substance that is an insulator. There are a number of dielectrics. There are lines for arc lighting underground and in operation. There are cable lines in the air where wires are all bunched together insulated from each other, and they are in successful operation. Everyone knows that incandescent light wire is under ground, and that a satisfactory insulation has been found for that. Now then, among the multitude of able men who have turned their attention in this direction, backed up by enormous capital, why cannot we get at some of the practical results which they have achieved? Stop theorizing. Do not let us attempt to build up a theory, but let us get at the practical facts which these men have reached through this laborious and expensive method which we all know as the experimental line. It will bury more money than the yellow fever will bury corpses in forty years. I make this suggestion for the benefit of myself and the other gentlemen who desire to know what is best to do in the way of insulation.

If Mr. Mason gets up—and I see he is moving in his chair—he will say that his simplex; if Mr. Candee gets up, they will say that is okonite; if Mr. McClees gets up, he will say that is kerite, and they will go through all the "ites" until your head swims, and you get no information. They will condemn this man and say he is getting up to advocate his own goods. I am not adverse to that myself, and I think the sooner you break down that idea and devote a part of your sessions to the purpose of getting information from the only source where you can get it—from the men and companies who have spent their money in this direction—until you abandon this fool notion that you are boosting one man at the expense of another, just so long you will be groping in the dark and have such a report as that presented by the committee, with blanks for some superintendent of an electric lighting station to fill in with information about something he knows nothing about.

Dr. A. F. Mason: I do not propose to be held back from speaking on this motion by any fear that some one will say that I tried to boom a wire. I do not believe there is on this floor a representative of any company who would degrade himself and abuse the privileges of this floor by any such course, and I do not believe anybody here will suspect me of such intent. The president will remember that the original motion made two years ago for the appointment of a committee on insulation, I had the honor to propose, and since that time I have felt moved to press the continuance of the committee or the appointment of new committees. So far the work has not been satisfactory, as the gentleman who presented this quasi report to-day has stated. The results have been nil so far. Personally I do not believe that all the laboratory experiments that these learned gentlemen and this committee could have made, would have been worth one farthing to the members of this Association. I do not believe that laboratory experiments upon insulation taken by themselves, give us reliable practical facts. Furthermore, in talking with gentlemen who are of very high standing as experimenters, I learn that such is their opinion. They allow that they cannot make a series of experiments, one exactly duplicating another. So much for that.

I think I may say that I fully agree with the gentleman from Nashville in his opinion that we shall get but very few answers to those questions if they are sent out, and if we got them, what is the value of each series of answers? First, it depends on the character of the man who writes, upon his ability, upon his frankness, upon many other factors, and the value of these factors cannot be estimated by the committee. I cannot conceive how we are going to reach the end we want through any such questions. I want to say right here and now that, anxious as I am for the facts that are aimed at by these questions, and earnestly desiring, as I do, that the whole electrical fraternity shall be acquainted with the facts regarding all insulations—among others, the fact that no one insulation is the best for all cases—yet, I say I do not believe it is a wise use to which this Association may be put—to quote the words of Mr. Morrison—to boom anybody's goods. I do not want the goods of which I have the honor to be proprietor to be boomed by this Association. I do not believe any other gentleman here wants his goods to be boomed in that way. Mr. President, I shall run the risk of some unkind person saying, "He did not want his goods tested thus," and put myself on the good nature of my brethren by making the motion that this report be accepted and the committee discharged.

The President: The pending motion is an amendment offered by Mr. Mason that the report be received and the committee discharged.

Mr. Morrison: I object to any such motion. I object to the closing of any channel of information for this Association. I do not think that the shutting off of any source of information that may have been opened in times past will be of benefit to the Association.

I am glad to receive information from Mr. Mason or from any other gentleman engaged in his line. We all know what an honest—I would say a modest set of men the wire men are. I would never accuse them of being very honest, but modest. But for my own sake, and the sake of the other members of this Association, I hope the gentleman's motion will not prevail. That committee is composed of the most intelligent men in the various lines of business which they follow. If you discharge them you are at the mercy of Mr. Mason and the wire men. If you continue the committee you have got an intelligent body of reference to whom you can refer these matters, and if Mr. Mason comes to me and says, "I have got the best insulated wire in the world," and gives me his samples, I can go to the committee and say Mr. Mason claims such and such properties for his goods, and then these despised laboratory experiments come in very well and you can take these to a chemist and he will tell you whether the constitutent parts of the insulator are such as will carry out the guarantee of the gentleman who offers the wire for sale.

I ask that the gentleman of this association will not vote to discharge that committee. It is a tough job to move to receive and approve a half finished report like the ones the committee has sent in for two or three years, but it is better than no report at all. They may wake up to the fact that the information is of importance to them and take enough time from their slumbers or pleasures to make up a report that is free from blanks and queries. I hope you will vote down the substitute and accept the report such as it is, because it is the best we can get at present.

The President: The chair desires to state in all fairness that this question has been before the Association several times, and at the Boston meeting the committee was continued upon the ground that sufficient money had not been provided by the Association to make certain experiments in this direction, but they were instructed to collate information. Dr. Moses, for the chairman, stated that they had considerable valuable information. The point now is, if you adopt this amendment or substitute you will treat all that valuable information as practically of no use. It will be in nobody's hand except as an archive and all the work that has been done will be lost. That is the way it presents itself to the chair. I simply state it so that you can vote intelligently. The question is on the motion to accept the report and discharge the committee.

This motion was lost.

The President: The substitute being lost the question now occurs on the original motion to accept the report and continue the committee.

Mr. Morris: I would offer as an amendment that we appoint an entirely new committee, partly of scientific gentlemen and partly of practical superintendents and let us have a report on the facts as nearly as we can get them

The President: Does Mr. Weeks accept the gentleman's suggestion?

Mr. Weeks: No, sir. I think it would be better to leave it in the hands in which it is now placed. They have organized a movement that will ultimately bear fruit. It is true that the first returns to these inquiries will be meagre and the burden of them will be to condemn underwriters' wire, so called. But as times go on, it seems to me, if this matter is pressed vigorously and intelligently, as these men who have been placed on this committee have the ability and power to press it, that we will get some very valuable results. It strikes me too that we will get from the superintendents of the companies who are engaged in actually using these insulators, the facts that we want. I appreciate the point of Mr. Mason, that it is not in the laboratory alone that these things are to be settled. We might get certain results in the laboratory that would not be borne out by the varying conditions under which these wires are used. I feel that the wise course would be to leave this in the hands of the committee now appointed.

The original motion to accept the report and continue the committee was then put and carried.

The President: We will take up the paper of Mr. S. S. Leonard, of Minneapolis, on "Petroleum as a Fuel." That will be now read by the secretary, or somebody in his absence.

Mr. Morrison: I conceive that to be a very important paper, and one that will attract a great deal of attention.

Mr. Allan V. Garratt read Mr. Leonard's paper on "Petroleum Fuel," which is as follows:

"PETROLEUM FUEL," BY S. S. LEONARD.

The use of petroleum is by no means of recent date. It was known to the ancient Greeks and Romans, being used by them for illuminating purposes, as they had no electric lights in that day. In fact, the word "Petroleum" is of Latin derivation, meaning "rock-oil." It has and is being used for various purposes, from the sure cure of numerous diseases to the generating of steam for electric light stations. It is found in many parts of the globe, although there is but a few localities that are especially noted for its production. In our own country, New York, Pennsylvania, Ohio and West Virginia, produce the greater part of the supply. Although it was known to the early settlers of these States, very little importance was attached to its value. I presume that there are none so young here but well remember the oil craze, and the saying which was heard almost daily of "So and so" has "struck ile;" perhaps some of the members of this convention were fortunate enough to strike "ile," and possibly some of them were unfortunate enough to have been struck by "ile." But to return to our subject, "Petroleum Fuel." To say that it is a new fuel would hardly be correct, for petroleum has been used as a fuel for a number of years. Experiments to determine its practicability as a fuel have been creating a great deal of attention from those interested in the matter for the last 20 years, and is now occupying the minds of some of our ablest engineers and inventors. Quoting from a very able paper on this subject by Chas. E. Ashcroft, which was published in the Boston *Journal of Commerce*, May 26th, 1888, Mr. Ashcroft says:

That the calorific power of petroleum for the purpose of generating steam, and the evaporation of water, is several times greater than that of ordinary coal. The successful use of oil as a fuel has, however, been of very recent date, yet so rapidly has it grown in favor, that to-day it is regarded as a strong competitor of coal for steam generating purposes, or where heat and fire are wanted.

It was with a great many knowing winks and nods of the head from the engineers and firemen, who laughed at the idea of making steam by the use of oil, that the writer attempted the use of petroleum as a fuel. Of course it would not work, and it did not work. Why? Because those who were using it did not want it to, as they were afraid some one would lose his job. We had seen enough of its workings to satisfy ourselves that it could be made a success, and the result is, that to-day we are saving from 20 to 25 per cent. on the cost of the fuel and 50 per cent. in labor, and these same men who laughed so hard on the start at our attempt to use oil, would feel that this world was a poor place to live in, were we to return to the use of coal, for not only their hearts but their backs would certainly be broken.

Its advantages over other fuels are many; in the first place, it is much easier handled, a steadier fire is easily maintained under your boilers, consequently the steam is kept at a more even pressure, a very important thing in the running of electric lights; there is no opening of furnace doors, allowing cold air to come in contact with the boilers, and there are no impurities in the oil such as abound in coal; when through with it by a simple turn of the wrist your fire is put out, and your ash pits are as clean as they were before the fire was started; in less time than it takes to tell it you can start the fire. It is only rivalled in handling by natural gas, and

even then, unless we have all the modern appliances for the handling of this gas, it is far easier to manipulate.

Permit me to describe the arrangements for the handling and use of this oil put in under the supervision of the writer.

The oil is received in tank cars holding from 90 to 150 barrels each (42 gallons to a barrel); from these cars it is drawn off through a valve in the bottom of the car to a storage tank or tanks, there being two of them, holding about 320 barrels each; these are placed underground so that the oil runs from the car into them by gravity; care should be taken not to spill the oil or stir it up more than is possible, as the odor from it is fully equal in strength to new mown hay if not quite as agreeable. To prevent the stirring up of the oil, the supply pipes entering through the top of the tanks run nearly to the bottom, so that the tanks are practically filled from the bottom. In the top of each tank are man-holes and a vent pipe; this latter is extended above the tanks a short distance. These tanks, which are boiler shaped, are placed end to end with a space of about eight feet between them; this gives room to get at the various pipes; they are joined together at the bottom by a pipe which also connects with the supply pipe running to the boiler room; then in the bottom of each is a drain pipe which will admit of cleaning them out whenever necessary; there is also a gauge glass in the end of each to show how much, if any, water is in them; there is also a gauge made by a copper float which indicates the amount of oil in each tank. In cold weather a small steam coil is inserted in the tank car around the mouth of the valve to heat the oil so that it will flow readily, for when the thermometer gets in the vicinity of 30 or 40 below, the oil is apt to be a little thick; care should be taken not to heat the oil too much, for, when hot, it generates considerable gas, which is not only very odorous but is really the cream of the fuel.

I think it an advantage to have the storage tanks underground, there being less danger from them in case of fire, and during the winter the oil is less likely to chill. An open light should never be used near them, although the oil itself is really hard to ignite unless heated to a certain degree; still there is apt to be more or less gas around, which is quite explosive if brought in contact with fire. The supply pipes to the furnaces are provided with a valve where they enter each tank, also one in the fire room; this pipe, a two and one-half inch one, is enlarged to a six inch for about four feet and in this six inch pipe a small steam pipe is inserted; with this the oil is heated from 130 to 140 degrees; this lightens it so that it burns more readily, or I should say is turned into gas.

We now come to the burners, which are also fed by gravity as the storage tanks, although underground are still higher than the furnaces.

One might suppose that owing to the recent introduction of petroleum as a fuel, that some difficulty might be experienced in obtaining a burner, but their name is legion, and they are as numerous as electric light systems, and like them in another respect, each man's is the best. Our experience has been that the more simple the burner the better the result. One that thoroughly vaporizes the oil before burning it is, we think, preferable to one that burns the oil. In the former there can possibly be no waste. In furnaces where we have been using this kind of a burner the bricks are as clean as they were the day they were put in.

Steam and hot air are the other ingredients that are used in connection with the oil, and an abundant supply of the latter we have found adds very much to the efficiency of the fire.

Regarding the proper settings circumstances will determine that to a certain extent, an excellent plan is given by the Standard Oil Company, in their pamphlet of "oil as a fuel;" this we have adopted with a few modifications which we found necessary by experience. There is no doubt but that a hotter fire can be obtained from oil than from coal or wood, and when properly used the smoke nuisance is solved which has been agitating the minds of the people of some of our large cities, for there is not a particle of smoke to be seen issuing from the stack, not even when everything is running full blast.

A word as to its danger: When properly put in and handled with ordinary care, or when good common sense is used in the use of this oil, I cannot see why it should be any more apt to cause trouble than coal, although the insurance companies insist on higher rates when used. I think it more from ignorance of the subject than from there being any more danger—at the same time I am willing to admit that it could be put in and used in such a way as to greatly increase the danger of fire. So might your house be wired for electric lights, piped for gas, a kerosene lamp hung, or your gasoline stove filled in such a manner that the fire risk is much greater than your neighbor who uses electric lights, gas, kerosene or gasoline the same as you do, but has his put in properly and handles it as it should be. As to its economy over coal I have already mentioned that there was a saving of from 20 to 25 per cent. on the cost of fuel, and from 40 to 50 per cent. in labor. From tests recently made by us, the following figures were obtained: 111.34 h. p. running six hours used 250 gals. of oil costing $5.50, or at the rate of 70c. per 100 h. p. per hour; 104.8 h. p. running six hours used 3,461 lbs. of coal, costing $5.45, or at the rate of 86c. per hundred h. p. per hour: Another test gave the following figures: 96.45 h. p. running 8 hours used 4014.75 lbs. of coal, costing $6.32, or 80c. per 100 h. p. per hour; 115.54 h. p. running 7 hours used 233 gals. of oil, costing $5.05, or 62c. per 100 h. p. per hour: On the above figures oil is from 17 to 32 per cent. cheaper than coal. The highest evaporation made with oil was 14.8 pounds of water per pound of oil with feed water at 103, and with coal 5.38 lbs. of water per pound of coal, feed water at 103. The coal used was a good grade of Illinois lump costing $3.15 per ton, but which is usually worth $3.25.

In the matter of labor one man can easily attend from seven to ten 150 h. p. boilers, and then have less to do than he would were he firing one boiler with coal. After a week's run with oil your boiler flues are much cleaner than they would be from the use of bituminous coal for one night, especially western coal. Your fire room can be kept as clean as your dynamo room. There being no ashes, you are saved the expense of handling them as well as the dirt, and the former is no small matter where some 20 tons of coal are being used every 24 hours. I might say that the above tests were made during a part of the day's run, and it is our opinion that a more favorable showing could be made with the oil, where a larger number of boilers are in use. It seems to work better with a good fire than where a small fire is sufficient. With our pipe lines affording a cheap method of transportation, the future of "petroleum fuel" is assured, and I think there is no doubt but with true Yankee ingenuity, a burner or some method will be brought forward by which the use of petroleum as a fuel will be greatly improved.

The President: In connection with this paper I desire to read the following letter, as due to Mr. Leonard:

MINNEAPOLIS, MINN., Aug. 22, 1888.
S. A. DUNCAN, ESQ., PITTSBURGH, PA.

My Dear Sir—I herewith hand you the paper on fuel oil that you requested me to write them here. All that I have to say is that if you take the time to look it over, and think after doing so that it is not worth the while to take up time that would undoubtedly be spent to better advantage by having it read before the Convention, do not hesitate to lay it one side, as no feelings would be hurt. Should you, however, think best to present it to the Convention, I shall feel very well pleased if I have been able to say anything that will be of any benefit to the Association. It will be impossible for me to be present. Yours very truly,

S. S. LEONARD.

I would just say that the way this matter came about was that being in Minneapolis some weeks ago I walked into his station and wanted to know where he got natural gas, and laughingly he said, "We use gas in a different way." Then the question came up as to the economies and so on, and I found that he obtained such satisfactory results from the use and was so entirely satisfied with the economies, as compared with his former experience with coal that I asked him to prepare this paper, and it is now before you for discussion. I hope you gentlemen will go into it.

Mr. Morrison: As Mr. Garratt was reading Mr. Leonard's article I asked Mr. Pope to analyze those figures. Here they are: 250 gallons of oil cost $5.50; that is seventy cents per 100 horse power per hour. Coal costs eighty-six cents per 100 horse power per hour, a difference of ten cents per 100 horse power per hour. If you take a station of 5,000 or 6,000 horse power and run a year that is a considerable item.

This paper is a very startling one to me. I saw it yesterday I think. It is a most startling one if the details are true. We have no reason to doubt the statements; I have none. If any gentleman has made any experiments in that direction that will throw a doubt on these statements, I hope he will get up and say so. In 1865, that is twenty off years ago, I was a telegraph operator at Parkersburg in West Virginia. They did not get coal enough for their use. There was a man named Shipley who was engineer in the Swan House, a tavern right across from the telegraph office, and there for the first time I saw the burning of petroleum. There was plenty of it there then. Wood County had got into the habit of squirting oil out of the ground as in Pennsylvania, and oil was very cheap. I think it is cheaper to-day than it was then. If this is true, I want to know something about it, for we will be running six or seven thousand horse power within the next six months or so.

There is another item not mentioned in the paper. It costs us twenty-five cents a load, with coal, to haul the ashes away. I have not at the end of my tongue the figures of our statements. I am sorry Mr. Evans is not here to give them, but we use a low grade of fuel. It costs a little less than three dollars a ton. It is known as screenings and soft slack coal. It has always been an open question with me whether there was very much economy in the end with it, but it costs well up to three dollars before you get through with it. Now, it costs you three men to handle it, and out of this trash that you burn the ashes are nearly 50 per cent. of the fuel you put on the grate bars. Of course, you must make allowance for those statements because I am making them off-hand. But I observe if we burn, say, 50 or 60 tons of coal of a night, we generally have 30 or 40 cart loads of ashes to haul away the next day. Now, that goes to show that pretty near half of the stuff comes out in the form of ashes and sand and slate from the mines, and so on. There is another item that you can charge up to the economy of this petroleum fuel. In the new station we are going to build, I shall equip one battery of boilers with coal oil. Mr. Weeks, of Kansas City, is going to make large additions to his plant, and I hope he will do exactly the same thing. What do you pay for coal in your country, Mr. Weeks?

Mr. Weeks: $2.56.

Mr. Morrison: What kind of coal?

Mr. Weeks: Not bituminous.

Mr. Morrison: How much do you use per horse power per hour?

Mr. Weeks: About six pounds.

Mr. Morrison: On a Buckeye engine?

Mr. Weeks: No; Ide engines.

Mr. Morrison: I would suggest that every gentleman who is a member of this Association and who contemplates any additions to his plants will take a copy of this report and analyze it carefully. If there is something he does not understand, let him ask Mr. Leonard to explain it, and then try it practically himself.

Mr. Frank Ridlon, Boston: I have been superintendent of a large coal tar company. From that material we got out various substances that were valuable for coloring matters. We finally came to the last portion of that which was known as dirt oil. It was used at that time for the making of glass' and was also sold latterly at a somewhat higher price for the creosoting of wood for railroad ties, spiles, etc. We at one time found it impossible to get a sale for that article, and when we had to sell it for about a dollar a barrel we found it cheaper to burn it, and we did burn it with very good satisfaction, although the apparatus for using it was very crude indeed, not only as to the economy of fuel but as to the wasting of fuel. We simply had a perforated plate and another plate that was not perforated underneath, and let the oil drip down upon it; but we found it a very fine material to use. Referring to the matter of ashes, that was quite an expensive matter—carrying some distance, so that when we could not get a dollar a barrel for it we found it cheaper than burning coke, for which we were then paying about $2.50 per chaldron.

Mr. DeCamp: I would like to ask how long Mr. Leonard has been using oil.

The President: The chair will state that he was there about the 10th of July and Mr. Leonard had then been using that oil several months. He had first made the experiment with smaller quantities of oil, but the com-

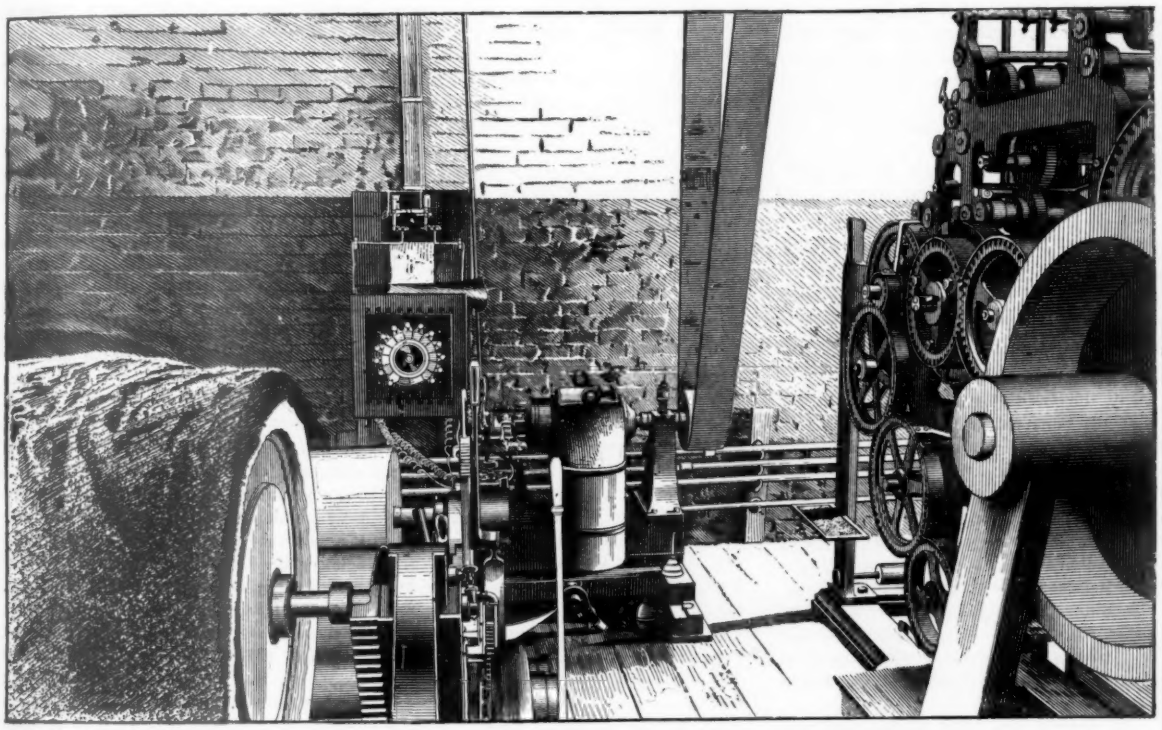


FIG. 2.—ANOTHER VIEW OF THE THOMSON ELECTRIC MOTOR RUNNING PRINTING PRESSES.

pany had got to that point where he had put these tanks in as reservoirs and they ran in a side track alongside his station and emptied into his reservoir tanks. It is as clean and nice a piece of business as I ever saw.

Mr. DeCamp: Mr. Leonard's paper is a very remarkable one. Some two or three years ago I paid some considerable attention to the subject of oil fuel. Several methods have been adopted in Philadelphia for the utilization of oil, but the parties who have adopted them have finally abandoned them. I was never able to learn just what their reasons were, but they used them with apparent success for some time and, from what they said, with great economy, and then they dropped it. During a residence of two years in the oil region I found that the people there who are controlling wells and who had every facility for getting cheap oil from the various refineries through the country would prefer to pay as high as $20 a ton for coal. Also there would be occassionally a man who would start up with an oil burning apparatus, but that would be abandoned. Taking those things in connection with the inquiries in Philadelphia, and the final results of their efforts there, led me to abandon them. As I see figures are presented in that paper on the first cost of the fuel as compared with coal. There is not a very material difference, but the labor item and other expenses extended to coal which would not be extended to this is quite sufficient to make that of very great interest to this Association. I have recently got through with a test of coal. I have been using one particular coal for about four years and we do not seem to have the benefit of the competition in the coal business. In fact we do not seem to be able to strike coal that is equal to it; so we are confined to that particular coal. But the result of a recent test made with a new coal, as compared with the coal we are now using, was a difference of eighty-five cents a ton. Our coal cost us in one instance sixty cents per hundred horse power per hour and the other, sixty-three cents, the sixty-three cents being the lowest priced coal.

Now we differ from Mr. Morrison; we do not use screenings. I have come to the conclusion in the last two or three years that the best coal was, taking all things into consideration, the cheapest coal to use. In the one case the cheaper coal gave about three cart loads of ashes—three and a half cart loads of ashes to every ton of coal and in the better class of coal it was a trifle less than two. Our ashes cost us, from one station, seventy-five cents a load to haul and from another station forty cents. There is a difference in our experience in using what we think is good clean coal. We have no refuse to contend with. In the comparison between these two coals on the point of labor I do not recollect just how many men there are in the boiler house, but it would have been necessary to have put one additional man in the boiler room, from the fact that the better coal would run a full fourteen hours without the fire being cleaned and with the other coal we would have to clean fires certainly sometimes during the run. That would necessitate another man as a laboring man in the fire room. I made up the estimate on those two coals. There is a difference of eighty-five cents a ton between them. The labor and everything else taken into consideration was equal to about $1.10 a ton. One coal cost us $2.90 put in the boiler hole and the other cost us $2.75. Our consumption of coal is about 12,000 tons a year. The figures presented by Mr. Leonard are just about on a par with the best coal we use; so that there is no doubt of the importance of that paper if Mr. Leonard is correct in his figures.

Mr. Perry, Providence, R. I.: Mr. President, the gentleman from Baltimore, who is using coal dust and soft coal mixed had had an experience in regard to the acid quite different from mine, although the net results of Mr. DeCamp's experiments, and also the net results of the experiments of the gentleman from Baltimore, were very similar, and they seem to be very much like the result of using the oil fuel. That is to say, about $\frac{63}{100}$ of a cent to $\frac{65}{100}$ of a cent per hour per horse-power. That was the result of his experience and also of Mr. DeCamp's. Last autumn, about a year ago, our company having decided to build a station for themselves, being simply lessees of some property and having determined on some radical changes in the arrangement of the steam plant, I thought it would be an excellent thing to put on some first-class steam engineers and ascertain, not what we might do by fancy firing and jockeying, but to ascertain just what we were doing in every day practice; and we selected for that purpose a gentleman very well known, who was trained under Mr. George H. Corliss, Mr. John T. Henthorn, a member of the American Society of Civil Engineers and also of the Society of Steam Engineers, and asked him to determine what we were doing. We made no changes whatever. The result was a horse-power for about $\frac{65}{100}$ of a cent per hour. We used for fuel, three parts of anthracite dust—not pea and dust, but simply the dust; no pea in it whatever—with one part of Pocahontas or an ordinary flat-top coal. The result of that was about 17 per cent. of ash. The gentleman from Baltimore spoke of 50 per cent., and that caused me to mention it—about 16 or 17 per cent. Our runs were good runs. We made 48 hour straight tests, running right through, two days and two nights. Having some power business, and also some all day business, we run our stations 24 hours. The result was—which confirms the statement of Mr. Morrison and also that of the gentleman from Philadelphia—about $\frac{62}{100}$ to $\frac{66}{100}$ of a cent per hour per horse-power, and in the ash, as I say, about 16 or 17 per cent. in weight. Now, another very peculiar thing was, that when we just concluded our first day's run, it came on raining and continued to rain for the whole 24 hours. So far as we were able to ascertain, there was not a change of a single light. The same hours were run, the same number of lights were run, and everything, but it took an average of 20 horse-power, the average of the 24 hours being at the rate, I think, of about 142 horse-power per hour for the 24 hours. The second day, when it was raining, and it did come down vigorously, it poured the whole 24 hours, it was just 162 horse-power per hour for the 24 hours. We are using underwriters' wire all the way through. We have no especial interruption from grounds except general leaks all along the line that might be induced. The results of coal using and of oil burning seem to be about the same in the four stations, the Baltimore, the Philadelphia, the Minneapolis and the Providence station.

Mr. Morrison: I would rather take the gentleman's statement than my guess work. The gentleman has stated these as actual facts from tests.

Mr. Perry: Yes. Our engines were indicated every twenty minutes.

Mr. Morrison: Now in regard to the ash.

Mr. Perry: As we intend to abandon the high speed engine—I should say the high pressure engine (we propose to run high speed the same as before, but we will use a compound engine and surface condenser), I wanted to know just what we were accomplishing with the high speed engine, and to ascertain what benefit we would derive from adopting the other engine. We shall go into the new station in the course of three or four months. We used an Armington & Sims engine. We have not yet fully decided what engine we are going to use, except that it will be a compound engine and surface condenser. We intend to arrange the station so as to get a uniform load while operating the engine.

The President: Did you include the cost of hauling refuse matter?

Mr. Perry: No, sir. That is simply the cost of the whole.

The President: Then you can figure twenty per cent at least for that?

Mr. Perry: It costs us twenty-eight cents a load to haul the ashes.

Prof. Van der Weyde: A year ago I had a rare opportunity to test the economy of coal compared with petroleum. I was testing a new style of dynamo in order to determine the economy of the alleged improvement. The parties interested in it concluded to make another test and by means of the power from a petroleum boiler. I was very glad of that. The petroleum boiler was furnished with a furnace. I had the consumption of petroleum watched carefully. I have not in my memory the correct figures, but I can tell you the upshot of the results obtained. The dynamo was tested also. The steam power furnished to it I had carefully tested with indicator diagram. I made the test as well as a conscientious scientific application could make it. The result was that when compared with the consumption of coal, the petroleum was a great deal dearer notwithstanding that coal is more expensive here in New York than in many other places. I remember the upshot only which was this—that as long as crude petroleum will cost more than forty cents a barrel it is cheaper to run under a slack coal. In stating that result to a prominent Philadelphia manufacturer he told me that they had had the free use of gasoline from some petroleum furnace there and so they used it for a time until the gasoline got more valuable in the market and they could not get it gratis any more, and they had to buy it. Then they stopped, because if they had to pay for the gasoline it would be much cheaper to use coal, and they returned to the use of coal.

Only where the peculiar circumstances admits of getting petroleum cheap can it be used to advantage. If that is not the case it cannot be used to advantage. For instance, in Russia they use petroleum largely because they have no coal, but in the City of New York I am perfectly satisfied that, notwithstanding there is some saving in the handling of the fuel when we use petroleum, that coal is cheaper in New York City.

Mr. Morrison: What did you pay for the petroleum, Professor?

Prof. Van der Weyde: The petroleum was $1 a barrel.

Mr. Morrison: I want to find out what this experiment is based on—the price per gallon for oil, and the price per ton for coal. I want to ask the gentleman upon what this experiment was based—the cost of the oil, the cost of the coal, the length of the test, etc.

The President: Can you inform the Association, Professor, the length of time of the test, and the cost of the fuel of each description?

Prof. Van der Weyde: The test for petroleum was for about a fortnight.

Mr. Morrison: How large a plant?

Prof. Van der Weyde: The plant was small. I must confess that the plant was not more than enough to furnish about 20 horse power.

Mr. Morrison: You used crude petroleum, I suppose?

Prof. Van der Weyde: Crude petroleum.

Mr. Morrison: It cost you how much?

Prof. Van der Weyde: A dollar a barrel. I made a calculation at that time that if we could have had the petroleum at 40 cents a barrel, then it would be cheaper. I must also say that the arrangement for consuming the petroleum was very fine—one of the best I have seen, while the arrangement for the coal consumption may not have been so perfect. It was an ordinary horizontal boiler.

Mr. Morrison: What did you pay for the coal?

Prof. Van der Weyde: I believe it was $3.50 a ton delivered at the place.

Mr. Weeks: What kind of coal?

Prof. Van der Weyde: Anthracite coal.

Mr. Morrison: Do you think that experiment would be as reliable as using, say, 100 horse-power?

Prof. Van der Weyde: That is a question I would decline to answer. My experiments were with an engine of about 20 horse-power.

Mr. Morrison: What was the difference in the cost?

Prof. Van der Weyde: I have not the figures in my mind, but I know this, that the result of my calculation was that when we could get petroleum for 40 cents a barrel, then we could make steam as cheap as with the coal.

Mr. Pendleton: In view of the discrepancy in the results, I thought it might be interesting, referring to Mr. De Camp's experience, to ask him whether he had ever heard of a petroleum fire burning the iron. I recollect many years ago, that that was the complaint of many engineers, and it might be interesting to know if he ever heard of such a result being caused by the discontinuance of the use of coal as a fuel.

Prof. Van der Weyde: I am glad Mr. Pendleton mentioned this, because in my observation for 14 days in a petroleum furnace I saw that it suffered greatly, and I was expecting that if it was used for a protracted time it would give out.

The President: Will Mr. DeCamp please answer the question of the gentleman?

Mr. DeCamp: I never was able to learn anything about that. The last and most important effort made in that direction was in a shoe factory. The proprietor of that factory is a man of very large means and rather a progressive man, and he had very small facilities for coal storage and he went to a very considerable expense, I judged from the looks of his place, to put in the boilers and power suitable for his factory. I suppose he used 50 horse-power. I do not know whether he ever published them or not, but he made statements very freely that he was saving a great deal of money in his fuel account. I do not think he ran more than six months when he abandoned it. Whether he found his boilers were burning out or not I never heard. I sent our engineer over to West Philadelphia at one time to look at an experimental plant put up there, but there was nothing that he learned at all satisfactory to himself or me either. Petroleum has been a drug on the market for a good many years and at points where there is a great deal of power used, and it is a mystery to me how it can be very much cheaper. It seems to me that would have been discovered sooner, because in certain parts of this State there is great trouble in getting rid of a certain class of petroleum. This is a statement I heard made by one of the officers of the Atlantic Refining Company. He made the proposition to me when we were hard pressed for steam at one of our stations. He offered to set up a locomotive boiler and put in oil to run it with, if we would go to some expense—the expense of putting it up. I figured over that for a while, and came to to the conclusion that I did not want to do it. I said to him, if this is what you state it is, we will use it all over. We were then burning about 12 tons of coal a day at one of our stations where we had every facility for handling oil. He said no, that would not do. The Atlantic Refining Company is a very large concern. He said that that product of the oil which was adapted to that sort of firing was limited; that any demand for it for fuel purposes would put the price up so high as to make it prohibitory.

Prof. Van der Weyde: Another illustration comes to my mind. In the City of Yonkers, at Hastings, there are gas works where petroleum is used to be converted into gas. They commenced with coal as fuel, and after a while they tried petroleum, and instructed by the experience I had before with a dynamo I told them I did not expect they would be satisfied. It turned out that way. They abandoned the use of petroleum and returned to the use of coal.

The President: The hour is getting very near adjournment and this is a very interesting subject. This question of burning out boilers with gas is all nonsense—with petroleum gas, because it is identically the same as natural gas when it is properly burned under boilers, and there are more boilers used with natural gas burning under them lasting longer than any with coal under them. In regard to the question of economy, the only thing I know about it is the statement of Mr. Leonard. Mr. Leonard is a practical man and is running a good sized station, and I have no doubt he will stand over the figures he has given. If these two points are such as to induce this Association to have a committee to see if can they get a few more statistics on this thing, all right. But, so far as the present discussion is concerned, it will have to close at this time.

Mr. Morrison: I hope we may be able to

hear from Mr. DeLand, before adjourning.

Mr. Pendleton: I beg to say in reply to Mr. Duncan's remark, that the action is different in burning gas under water and burning the petroleum in the manner spoken of by the gentleman who presented the paper. In one case you have the pure gas burning and in the other case you have a mixture of steam and hot air. It is a well known chemical fact that at white heat, usually steam is decomposed and the action upon the iron in the vicinity would be very different. I am aware that the use of petroleum for fuel is by no means a novel subject. I recollect in my boyhood that a locomotive boiler was put up and a great many gentlemen here may recollect it—it was put up in a battery and petroleum was used there for several days, being placed through roses in the fire box, and afterwards when the question came up of burning the natural gas it was some time before they could manage to control it properly; but it became finally a great success. I only call attention to the fact that while the subject is worthy of the most careful attention of any committee, yet the burning of natural gas by no means solves the question of burning petroleum where hot steam and air are burned with it.

Mr. Sunny, Chicago: The company that I am connected with has a station just south of the city limits in Chicago. Our coal cost us $900 a month. We were burning it by the car load. The coal was wet at the mines; it was generally wet when it was weighed, and by the time the car got to us we found it short about 20 per cent. in weight, so we got about $700 worth of coal and paid $900 for it. On investigating this question of oil burning and corresponding with a large number of gentlemen who had some experience and who had been using oil burners for a long period, we found that in most instances the same results could be had out of two barrels of oil as out of a ton of ordinary bituminous coal. Our coal was costing us about $3.00 a ton. We could buy oil for 60 cents a barrel, so that the equivalent of one ton of coal would be $1.80, making a saving of $1.20 on a ton of coal. The saving that we expected to get on the change from coal to oil figures at the difference between $957 a month and $540 a month, and we make a saving of $45 for the salary of a coal passer, and $12 for hauling the coal in and taking care of the ashes. We expect to make in any event a saving of 35 per cent., although the figures guaranteed to us by the men who are handling oil burners, and the figures are said to be reliable by men who have experimented, would indicate that there will be a saving of 40 per cent.

With regard to Mr. Leonard's figures as to the economy, I should say that this fact ought to be taken into consideration—that the oil cost him perhaps two and a quarter cents a gallon in Minneapolis while it costs a cent and three quarters in Chicago. With regard to the burning out of the boilers I found that that largely depended on whether you could distribute your flames all around the boiler. But there are several methods whereby you can distribute your flame so equally that there will be no effect on the boiler whatever, and you can get the same result out of the use of oil as you get from the use of coal with respect to the burning of the boilers.

Mr. Fred. DeLand, Chicago: Mr. DeCamp asked how long the experiments at Minneapolis had been carried on—about nine months if I remember rightly. It was started the latter part of December or January. There is an experiment going on at New Orleans that will probably be interesting. It is the Louisiana Electric Light and Power Company. Morris J. Hart is the general manager and he would probably give you gentlemen all the information you desire if you correspond with him. I was down there several months ago. It is stated he has the largest station in the would in capacity. He has a capacity of nearly three thousand arc lights. The horse power, I believe, is over 1,200. He has been in the habit of purchasing his coal and having it shipped in barges down the Ohio and Mississippi river and wheeled in barrels 400 yards from the dock into his station. He found that by using oil he could save thirty-one per cent. and he brought that about in this way: He arranged to purchase tank cars, I believe they are called. He purchased his oil, of course, from the Standard Oil Company. He sunk two large tanks in the ground, each containing 100,000 barrels of oil. The switch passes his station. The cars are brought down to the tank, emptied there and taken back. The saving came about in the wheeling out of the ashes, the cost of hauling the coal from the barge to the fire room, the doing away with one or more firemen and other little incidentals; but the net result at that time was a saving of thirty-one per cent. over the cost of burning coal. I know that Mr. Hart would gladly give this information to any one who would correspond with him.

Mr. Colvin, Baltimore: I was at that station a few days ago, and the situation there is interesting. He has one battery of boilers running by petroleum, and another running by coal right next to it. I could not give any technical data, but I could get it of Mr. Hart. Mr. Hart's brother, I believe, is in the city.

Mr. DeLand: I would like to say that the time I speak of was in March or April, and they were then burning coal. Mr. Hart told me at that time that he was going to do away with the consumption of coal as soon as the question was definitely settled.

Mr. Colvin: I was there two weeks ago, sir.

The President: This is certainly an interesting discussion, but we will have to pass it and adjourn until to-morrow morning at such hour as will suit the convenience of the Convention. Before doing so I desire to announce the Committee on Place of Meeting, which will be as follows: Brown, of Chicago; Weeks, of Kansas City; Officer, of Council Bluffs; DeCamp, of Philadelphia; and Stanley, of Bridgeport.

The first business to-morrow morning is this underground question, and an exhibition, I understand, will be made for the information of the gentlemen of the Convention.

On motion of Mr. Morrison, the Convention then adjourned until Thursday morning at 10 o'clock.

THURSDAY'S PROCEEDINGS.

Forenoon Session.

The President: Gentlemen, this morning's session is to be devoted to the question of underground conduits or conductors in the City of New York. We will have read all communications and clear up the general business on the secretary's table, after which we will take up Mr. S. S. Wheeler's paper, then the paper by Mr. E. G. Acheson, and then the one by Mr. A. C. Chenoweth.

If the Convention in its wisdom shall determine that this morning's session shall be extended so as to include this subject we may possibly not be obliged to hold an afternoon session, but my own judgment is that we will not be satisfied unless we take up most of the day. This will necessitate a very close attention to the business on the part of gentlemen in attendance, and the chair hopes they will remain in their seats so as to be able to participate in the debate at any moment. That will leave us the question of motors and motor power and the distribution of power for to-morrow morning, and possibly (as the afternoon session, by order of the Convention yesterday, has been set apart for the consideration of the question of the revision of the Constitution) it may be likely that the underground question and the consideration of the revision of the Constitution will occupy the whole day's session. If that should be the case you can readily see the necessity of a close attention to business, in order that we may finish up the proceedings to-morrow. I, therefore, ask the prompt attendance of every gentleman. The secretary has some communications to read.

(The secretary then read a communication from Mr. Somerville P. Tuck, in relation to the Paris International Exposition of 1889.)

The President: This communication will be received and filed, and the gentlemen who desire to look into the matter will find blanks on the secretary's table, and I think, in view of the importance of the general exhibit which is to be made at that time, that we will all be interested in at least looking up the matter.

(The Secretary next read a communication from James Allison, President of the Centenntal Exposition of Cincinnati.)

The President: The communication will be received and filed.

Mr. Foote: In behalf of that communication, Mr. President, I wish to say that the Centennial Exposition in Cincinnati will probably show the best electrical exhibits ever seen in this country. We are to have a grand display showing electricity in competition with gas, and I think it would be well for every member of the Association to go to Cincinnati and see it. I would make the announcement, in behalf of the Commissioners of the Exposition, that the members of this Association who will call at the secretary's office and present their cards of membershtp in this Association will be given tickets of admission to the exposition.

The President: Gentlemen, you have heard the statement that those who bear cards of membership in this Association and who intend going to the Cincinnati Exposition will have a card furnished them which will admit them to the Exposition free.

The secretary next read a communication from Mr. McDonald, of Fort Wayne, Indiana, and also a communication, attached to the former, from R. B. Rossington:

The President: Gentlemen, you have heard the communication. It will be received and filed, and the chair would suggest that each member of this Association engaged in the lighting business should file with the secretary a petition regarding the question of the classification of freight rates for carbons. That being done, we will then take up the subject through the Executive Committee, and may possibly be able to obtain something that will benefit us all. There being no objection, that will be the action, and the communication will be referred to the Executive Committee. The secretary has already, under direction of the Executive Committee, sent out communications to the different companies, but has received very meagre responses. Now, gentlemen, it remains with yourselves whether you will take this subject up and press it. The secretary can do nothing until he receives sufficient petitions to act upon. If gentlemen will promptly file petitions, or a statement of their views in regard to this matter with the secretary, the Executive Committee will at once attend to it.

The secretary next read a communication from Prof. Elihu Thomson, resigning as Chairman of Committee on Insulation. On motion, accepted.

Mr. Mason: I move that the chair be instructed to appoint a substitute, and that the committee shall appoint their own chairman. Carried.

Mr. Foote: Before we proceed with Mr. Wheeler's paper, Mr. President, I ask permission to offer a resolution touching the address of Mayor Hewitt, yesterday:

Whereas, Abram S. Hewitt, Mayor of New York City, has honored this Association with an address of welcome; and,

Whereas, in his address, he has given a concise and impressive presentation of the importance to civilization of the utilization of the electrical force in the mechanical service of the people, which is second to none ever before offered; and,

Whereas, In so doing he has announced sentiments indicative of the man in his complex character of philosopher, statesman, politician and master of business affairs,

Therefore, be it resolved, That, as a mark of appreciation of his masterful grasp of the importance of the subject, his clear sighted and generous presentation of it, and his kindly courtesy, the secretary of this Association, be and he is hereby directed to print an authorized copy of said address in pamphlet form and supply the same to members of the Association at a price ten per cent. in advance of the cost of production.

A Member: I second that resolution.

The President: Gentlemen, you have heard the resolution read. What is the pleasure of the Convention?

Dr. Moses: I would respectfully suggest to the mover of the resolution that the question of cost of the pamphlet be entirely eliminated from it, and that instead of the publication of the address, since that address has been read by several millions of people this morning in the newspapers, there is no necessity for us to circulate it. It will become a part of the printed proceedings of our meeting, anyway. I would suggest, therefore, that the thanks of this Association be tendered to the Mayor, simply.

Mr. Foote: Mr. President, I wish to explain why I offer the resolution. I want to get the address in full, in an authorized shape from this Association, for a use which I think will meet the approval of every person here. In Mr. Hewitt's remarks about the importance of the re-distribution of power to the people, he expressed identically the same sentiments that I heard expressed within the last four weeks by the president of the Commercial Club of Cincinnati. About two weeks ago I was requested by an officer of one of the leading banks of Cincinnati to go with him to the exposition and show him the electrical exhibit there in its commercial relation. He brought with him an officer of the National Banking Association. The National Banking Association will hold their meeting in Cincinnati in October. Their question to me was: "Will the stocks of electric companies become dividend paying stocks?" That is the point they are looking after. Now, I wanted to get this paper in an authorized shape to distribute to the members of that National Banking Association. I believe there are some 3,000 of them, and I am ready to give my personal order for 3,000 copies of the pamphlet if it is issued. I wish to say also, that I would like to have the pamphlet prefaced by the address of our president in opening our sessions, showing the scope and the meaning and the importance of the electrical industry as it now stands.

Mr. Steuart: I want to add my approval to this resolution, and my voice in favor of having the matter carried out to an execution. I listened with the utmost pleasure to the address of Mr. Hewitt yesterday, and I am sure that I express the feeling of every member of this Association when I say that it is the very best presentation of the importance of this subject in which we are all interested that has ever been made. It is the most practical, sensible and intelligent presentation of this very difficult and much mooted question of what is to be done with the electric light wires, that has ever been put before us, or called to the attention of the public. Now, I know that it is so in our own town, and I feel that it is equally the case in almost every town in which our delegates live, that the authorities are ignorantly striving to do just what Mayor Hewitt told us they had been striving to do in this town—trying to put the electric light wires underground, without any knowledge whatever of the conditions necessary; and I think that the address of Mayor Hewitt, coming as it does from a man who stands prominently before the people of this country, not only as the Mayor of the greatest city in the land, but also as one of the recognized leaders of the best and most intelligent thought among the people, will go far to quiet the difficulties that all of us have met with in the municipal bodies of our cities upon this subject. I therefore hope that the resolution will be adopted, and the address circulated as widely as possible.

The President: Are there any other remarks on the resolution? The scope of the resolution is that we take the address of Mayor Hewitt from the official notes of our own stenographer, knowing that it is such, with the endorsement of this Association, it being one of its official papers, and print it in pamphlet form, so that the members of this Association can have as many copies as they please for distribution. All in favor of the adoption of the resolution will vote aye.

The motion prevailed.

Dr. Moses: It has been very properly suggested that the remarks of Mayor Hewitt yesterday, while being very commendable and beautiful, yet rested upon a foundation. That ought to appear, too, in the pamphlet,

because he spoke very much of the progress of the industry which was so clearly set forth in the report of the president. Now, it would, perhaps, be a good idea to embody the two, since they had reference to the same subject. I would, therefore, make this motion: That the report of the president be added to the material in this pamphlet which is to be published; that is to say, that the report of the president and the address of Mayor Hewitt be printed in the same pamphlet for distribution.

A Member: I second the motion.

The President: It is a little out of order but if there is no objection to a re-consideration of the last vote, the chair will entertain it.

(The last vote, by which the resolution of Mr. Foote was adopted, was re-considered.)

The President: If their is no objection, the chair will take the resolution as offered by Mr. Foote to include the motion just made by Dr. Moses. There seems to be no objection, and a vote will now be taken on adopting the resolution as thus amended. Those in favor of it will say aye.

(Adopted.)

Mr. Steuart: I have a resolution which I want to offer, if this is the proper time.

The President: Let the resolution be read.

Mr. Steuart: My resolution is this: That the chair appoint a committee of five to consider the recommendations of the president in his opening address, and report at this Convention. Carried.

The President: The chair will name the members of that committee later on. We will now have the paper from Mr. Wheeler.

Mr. S. S. Wheeler, of New York, then read a paper on "Conductors of New York," which we will publish in another issue. It reviewed the work done by the Subway Commissioners of New York.

The President: If any gentleman wishes to ask Mr. Wheeler any questions on the subject he has discussed in his paper, it might be well for them to put those questions now before they slip from mind.

Mr. Lynch: I would like to ask Mr. Wheeler the estimated cost of laying these conduits.

Mr. Wheeler: I am not very well prepared to give the cost, but if Mr. Leslie, the manager of the Construction Company, who is present, will do so, I think he can probably answer Mr. Lynch's inquiry.

Mr. Leslie: I do not think it would be possible to give an intelligent reply to that question, because the cost of construction varies very much, as the circumstances vary. In some cases the engineering difficulties are easily overcome, while in other cases they are very difficult indeed. Then, again, the character of the excavation has a very great deal to do with it. It is a hard matter to say what the cost would be, unless the number of conduits and the side conduits, and so on, are specified.

Mr. DeCamp: I would like to understand exactly what Mr. Lynch's question was? I didn't quite catch it.

Mr. Lynch: My question referred to the cost of the conduits laid in the streets of New York, with a manhole in each block.

Mr. DeCamp: Do I understand that all this great work has been going on here in New York without anybody understanding what it is going to cost?

Dr. Van der Weyde: I suppose it would be very necessary to know the circumstances of each case first in order to tell what the cost would be. I have noticed that the difficulties are very great in some places. But where it is all plain work, with no great engineering difficulties to overcome, it would be interesting to know what the expense is.

The President: Gentlemen, this is getting into the discussion which is to be had later. The design of the chair was to afford an opportunity to gentlemen to put questions to Mr. Wheeler about matters which they might forget by and by and could not carry over to the general discussion.

Mr. Morris: Mr. Wheeler spoke of their being 9,000 miles of underground wires in the City of London. I would like to ask him whether those are high tension wires, and also as to what was the efficiency of the service.

Mr. Wheeler: I had stated already in the paper that there were practically no high tension currents in London, and that the wires put underground were put there by the government.

Mr. Lynch: Mr. Wheeler stated also that there was a conduit in 25th street. I would like to know if any means have been devised for getting the wires from the poles into those conduits, or whether any supplementary conduits have been provided by which the wires could be run to customers living in the block.

Mr. Wheeler: I also stated that the Johnstone Company's conduit had been authorized as a distributing system to be laid on Broadway and that it could be used in 25th street, but that the choice of a distributing system was left to the company, and if they could find a better system, why, of course, they could use it. It does not seem to me very difficult to get wires from a manhole to a pole. There are several hundred of them at the corner of 23d street and Broadway, telephone wires, coming up in tubes from the manhole and going out on the poles. The same thing exactly can be done with the electric light wires. The question that is most difficult to answer is how to distribute them cheaply to each house; not how to get them to a manhole.

Mr. Lynch: Can the gentleman tell me if any practical trial has ever been made of the Johnstone system for electric lighting wires?

Mr. Wheeler: I am not informed as to that. I understood Mr. Johnstone was to be here himself.

Mr. DeCamp: I will say in regard to the Johnstone conduits—I presume these are the same that are used in Philadelphia—that it is a very good form of conduit. It is expensive, but I believe it is perhaps the best conduit we have. I am free to say, at any rate, that it is the best form of conduit that has ever been brought to my attention; but we have never got anything to put into it yet that answers the purpose.

Mr. Lynch: As I understand it, the Subway Company which lays down the conduit charges a rental for its use, and the company whose wires are to be put into it are supposed to make an arrangement with the Subway Company to put down supplemental conduits and connect the wires therein. Now, I want to find out if the electric light companies are responsible for all work of that kind,—if they are directly responsible for the wires and the supplementary conduits?

Mr. Wheeler: I think that question better be referred to Mr. Leslie, who represents the Conduit Company.

Mr. Leslie: What is it?

Mr. Lynch: The Subway Company furnish the conduits in the street. As I understand, Mr. Wheeler, the electric light companies are obliged to put some style of supplementary conduit for the purpose of getting from the main wires to the electric lamps hanging in the street. Now, the point I want to find out is: are the electric light companies responsible for the proper working of the supplementary conduits, and also for the insulation of the wires to be place, not only in the trunk lines, but also in the supplementary conduits.

Mr. Leslie: I do not see wherein the question of responsibility is important in the question of the practicability of operating electric light current. I will say that the company that Mr. Lynch represents has been furnished with information on all these points.

Mr. Lynch: I do not appear here as representing any company. My connection with the Illuminating Company was broken off some time ago. I appear here asking for information as a member of this Association. Now, as I understand it, the Subway Commissioners say: Here is a system which we think the electric light companies should put down and should be responsible for, besides paying for it.

Mr. Leslie: I believe Mr. Wheeler represents the Subway Commissioners. You better ask him that question. (Laughter).

The President: Gentlemen, this is getting off from the main point, and we are getting into the general topic. The chair will have to stop this discussion at this point, and ask these gentlemen to be present this afternoon, because it is very evident there are going to be several questions that will have to be answered.

We will now take up the next paper, which is on the subject of Disruptive Discharges in Underground Cables, by Mr. E. G. Acheson.

Mr. E. J. Acheson then read his paper.

The President: The next paper will be a Description of an Underground Conduit, by A. C. Chenoweth.

Mr. A. C Chenoweth then read his paper.

The President: Now, gentlemen, you understand that when we adjourn, which we will do as soon as a few announcements are made, it is with a view of having an afternoon session devoted to the discussion of the three topics which have been presented this morning, and I desire to ask every member to be prompt in attendance, I know there are many of our members who are exceedingly anxious to participate in this discussion.

On the Committee on President's Message, the chair will appoint Messrs. Arthur Steuart, of Baltimore; A. F. Mason, of Boston; J. Frank Morrison, of Baltimore; E. R. Weeks, of Kansas City; and H. D. Stanley, of Bridgeport, Conn.

I understand that the Brush Electric Light Company have commenced putting in their cables at the corner of Fifteenth street and Broadway. Before we adjourn I would like to ask Mr. Wheeler if he knows whether they will be at work for the next two hours, and if so we will arrange to allow those of us who wish to see them at work an opportunity to go there.

Mr. Wheeler: The workmen will be at work there until the members of this Association come to see them. I think they go to dinner about half-past twelve.

The President: Then, gentlemen, we have not much more time than is necessary to get lunch and to go there, and get back here in time for our afternoon session.

Mr. Lynch: Before we adjourn, I would offer the following resolution, which was adopted.

"Resolved, That a committee of five be appointed by the chair to examine into and report upon the systems of underground conduits for underground conductors and conduits now in operation and the number of wires actually in use in those conduits, and report at the next convention of this Association."

The President: If there is no objection and no further business of a routine nature, we will now adjourn until half-past two o'clock this afternoon, at which time a discussion will take place upon the subjects presented to us this morning.

AFTERNOON SESSION.—August 30.

The President called the meeting to order at 2.30 P. M.

The President: In the absence of the secretary I will read the following communications which have been handed in:

"If desired by the members arrangements will be made for those attending the Broadway Theater to see the electric light plant there. As this plant is a very complete one and was installed under the inspection of the Navy officers it has many interesting points. C. J. FIELD."

The president also read an invitation from the Shultz Belting Company to examine at an establishment in this city a belt said to be the largest in this country.

The President: We are now ready for the discussion of the three papers which were read this morning. I see that Mr. Wheeler is present. Some of the gentlemen after the reading of this paper were asking some questions, which the chair stopped, as they were leading to a general discussion, but Dr. Wheeler will be ready now to answer any questions which may be asked him.

Mr. Lynch: I would like to ask Dr. Wheeler what number of wires it is proposed to put into these two and a half inch ducts.

Dr. Wheeler: I do not know exactly how many they propose to put in. I suppose it will depend on how many the ducts will hold. But there is now being drawn into them a cable containing eight arc light conductors each one of which is equal to a number four wire. They are made a trifle larger than the ordinary overhead conductors. That makes a cable which, including the lead covering, is about two inches in diameter. I should think it hardly advisable to draw a larger cable than that through these tubes; but hereafter probably there will be no cables drawn in containing more than one arc light conductor. They will be drawn in singly. The objection to the cable containing a number of conductors is that it limits the use of the cable to carrying a number of wires all forming the positive or negative side of the circuit, while if you make them up into single conductor cables you can arrange them to suit the convenience of business, and you have an increased amount of insulation between opposite wires.

Mr. Lynch: How far is this cable to run, Dr. Wheeler?

Dr. Wheeler: From 14th street to 34th street on Broadway.

Mr. Lynch: What is it to be used for—trunk lines?

Dr. Wheeler: I do not know exactly; I think not from the fact that it is proposed to cut it in two at each manhole.

Mr. Lynch: Have any supplementary conduits been made?

Dr. Wheeler: None have been laid that I know of for the use of arc light companies. The method has been adopted and the materials are being gotten ready to lay a system from 14th street to 34th street on Broadway.

Mr. Lynch: Is that the Johnstone system you spoke about?

Dr. Wheeler: Yes, sir.

Mr. Lynch: What is it proposed to charge as rental per mile?

Dr. Wheeler: I do not know. For that I will have to refer to the representatives of the conduit company.

The President: Dr. Wheeler, will you allow me to ask you a question? If the city authorities have charge of the streets and are responsible for that conduit going in there, how then are you going to hold the owners of the lateral wires responsible for anything at all? How do you propose to do that? Has the Commission got any plan on that point?

Dr. Wheeler: It occurs to me that that is a question of law and I am here as an electrician—not that I have any objection to answering the question, but I do not know the answer.

The President: I see. But is the representative of the law department here?

Dr. Wheeler: I would like to refer that question to Commissioner Gibbens, if he is present. I do not see him.

The President: We are seeking for information and we are as desirous of a solution of the problem as the municipal authorities are. When we get to a point where there is a dead line drawn and the municipal authorities cannot give us any information we have got to stop right there. If there is a point where we can give you information we are desirous of aiding you.

Dr. Wheeler: I am very desirous of having all possible information given to the Association in order to make the conclusion reached as valuable as possible, but in the absence of Mr. Gibbens, perhaps Mr. Leslie, who is present, and is the manager of Subway Company, might answer that question.

The President: You understand the proposition, sir—that as the municipal authorities by law take charge of the mains and regulate the size of the conductors, etc., and become responsible for those mains in the street, then, as I understood the proposition this morning, the companies who would feed off from those conduits would be responsible for the lateral mains. Is that correct? Now then what we want to know, if we can get the information, is this—where the responsibility of one commences and where the responsibility of the other ends. If we can get that we can possibly get into the meat of this business.

Mr. Leslie: As I stated this morning, I think the responsibility of the Subway Company ends in providing a suitable subway for the accommodation of such conductors as any electric light company or any other com-

pany may see fit to draw therein. They are responsible for the kind of insulation and for the operation of their own plant; they own it; we do not. We simply own subways which we lease to them.

The President: Then, in other words, as I understand it, the city authorities have practically made a monopoly of the underground business of the streets and given it to a certain company without any specifications as to the character of the conditions that the sub-companies must undertake to fulfill in making connections with the main conduit system. Is that it?

Mr. Leslie: In the first place, as I understand it, when the commission was created each and every party interested was invited to submit its plans for such a system as in their judgment might be most suitable to their business purposes. Having failed to do so, the Subway Company has since observed the same practice, and each and every company in the City of New York doing business here has been invited to state what in their judgment would be most suitable for their purposes. I think the attitude of the Subway Company in that respect has been most consistent. If a man wants anything, and asks for it and gets it, I do not see that he can ask for any more.

The President: Then, as matter of fact, the Subway Commission of the city does not say to the electric lighting companies that they must observe proper sizes of wire, and everything of that kind. They leave that to the discretion of the company.

Mr. Leslie: Entirely so; yes, sir.

The President: They simply ask them to make a recommendation?

Mr. Leslie: They ask them to go underground.

The President: And if it does not suit the conduit company, what then?

Mr. Leslie: We have had no such emergency arise, as yet.

The President: Is there a basis then established by the Subway Commission or the company under the Subway Commission—is there a set of fixed charges established?

Mr. Leslie: Yes, sir.

The President: That has been furnished to the companies?

Mr. Leslie: Yes, sir.

The President: Have you received answers from the companies in regard to that question?

Mr. Leslie: We have met with no opposition in that respect from any company in the city except one.

The President: They are all perfectly satisfied with the rate of charges?

Mr. Leslie: They appear to be so. They think it to be just and equitable.

The President: In the furnishing of this subway, do you give any guarantees to these companies as to the permanency and the reliability of the system that you put in?

Mr. Leslie: We agree to keep the subways in good order.

The President: Practically you agree to maintain them free from trouble?

Mr. Leslie: Yes, sir. But if anything that could not be anticipated should arise to interfere with their business they would be in a position to be reimbursed for any loss they might have incurred during that time.

The President: Then, practically you do give them a guarantee?

Mr. Leslie: We guarantee to give proper subway facilities, or we do not charge any rent; that is the best we can do. If we should happen to have some extraordinary accident which no one could anticipate or provide against, in that case we should, of course, abate any rental until such time as we could put the subways in good condition.

The President: Then there are no conditions by which a company which is held responsible for lighting to the public could obtain redress for lights being cut out for a period which would be practically inconvenient and would cause the public considerable delay?

Mr. Leslie: I do not know of any guarantee beyond that which I have stated.

The President: Yes, that is what I understand. Then it is the companies which practically loose the amount of revenue that would be derived instead of the Subway Company that puts in these conduits?

Mr. Leslie: Well, I presume so. They do so now with the overhead system.

Mr. Perry: This is a subject that is entirely new to us and we may have to meet it in our own various systems, and I would like to ask what are the rates of tariff which are established here, and if the City of New York gives into the hands of a corporation the right to lay these subways without any limitations as to what tariff they should charge, and then say to the companies you must go in, no matter what the rates are? I would ask if there is any limitation of the tariff and what the rates of the tariff as established are?

Mr. Leslie: I will say with regard to that matter that the companies are amply protected. The law on that subject reads that such a rental shall be charged as is fair and equitable. Any company imagining itself imposed upon in the matter of rental can have recourse to the Board of Electrical Control, which has the right of revision at all times. I regret that I have not with me a copy of the law on the subject, which I imagine from the inquiries which have been made would have gone very far to enlighten the gentlemen present. There is no opportunity for unjust action.

Mr. Perry: The other question which I ask the gentleman, through the chair, was what are the rates of tariff as established, briefly?

The President: The question, Mr. Leslie of the gentlemen, is if you have no objection to giving them what are the rates as now established?

Mr. Leslie: When I came up to this Convention on this morning, I had no idea that I should be called upon to furnish any information whatsoever, and therefore I have not provided myself with statistics. I came here to listen to Dr. Wheeler's paper, which I understood he was to read. Nevertheless, if my memory serves me right, I have no hesitation in saying that our schedule of rentals is $1,000 per mile per annum, for a three inch duct; $800 per mile per annum, for a two and a half inch duct; $750 per mile per annum, for a two inch duct; $550 per mile per annum, for an inch and a half duct. I will say that, with regard to the two inch duct, I am not clear whether it is $750 or $650, not having the data, as I said before, with me.

The President: You will understand, Mr. Leslie, that these questions that we ask are not asked in an inquisitive way to ascertain the private business of the Subway Company; but this City of New York has been looked to from all over the United States as the point where this question is to be solved. We have been invited by the Mayor to go into the merits of this case if we can, but there is no use in going into the electric part of it unless we can get at the financial part of it too. You must not think these questions that are asked you are simply put to ascertain the business of this corporation. It might seem that they were put in that spirit, but I want to assure you that that is not the case. We want to put these two things together and see what we can make out of it.

Mr. Leslie: I appreciate that, Mr. President, and I want to say that, while the scope of our operations is local, yet we recognize the fact that the underground problem is universal, after all, in its application, and that in most of the prominent cities of the United States you are all face to face with the same question, and that the developments of underground facilities in other cities is going to be directly and indirectly a great help to us here in New York. I desire to say further, that if an individual member of the Convention desires any more definite information upon the underground system which we may possess, and if he will apply at our office at 18 Cortlandt street, in this city, we will very gladly give him all the information that we have.

Mr. DeCamp: As I understand the matter, when this question was referred to the Subway Committee, they invited the different electrical interests to state to them what was necessary for a successful solution of the problem of laying underground wires. These different electrical interests, particularly the electric light interests, made no response to that, for the reason which is manifest to every man engaged in the electric light business, but they had no suggestions to make, because they knew nothing. On the strength of that the Subway Commission took upon themselves the responsibility of deciding upon some conduit which, in their judgment, would answer the purpose. Those conduits have been put down, not upon any merit that has been demonstrated that they possess, but as mere mechanical constructions they seemed the proper thing. After that is done then comes the pressure to have the electric light companies put their wires in them. That pressure is brought to bear very forcibly, because it is backed up by legislation. They are the parties who have assumed the responsibility of deciding for the electrical companies in putting down a certain conduit; they throw off the mantle of their responsibility and say, "Gentlemen, occupy those conduits at a rental of so much a mile." The only risk that they take in the matter is in keeping the conduits in repair. That is one which they cannot very well shirk. They throw the burden on the electric light companies, and as the chairman very pertinently puts it, who is responsible to the electric light companies for the loss of service to the public in the municipality by reason of the failure of the conduit during the time it is necessary to repair them? Not only that, but the failure on the part of a cable or conductor that they put in, though not upon their own judgment, but upon the judgment of the parties who put the conduit down.

There is a consequential consideration or risk there, which, in my judgment, it is unfair to impose upon anybody. There is only one certain element in that for the companies using that conduit, and that is to pay rent. But leaving that right there, this is what has always occurred to me from the time this question was agitated. It has been taken hold of at the wrong end absolutely. I never saw a more preposterous method of accomplishing a thing in my life. It is taken hold of right at the wrong end. Mr. Lynch asked a question this morning about a certain conduit in Philadelphia. That that conduit in my judgment is a good one goes for naught. I do not care how good it is, and I do not care how cheaply it should be built, but I have got absolutely nothing to put in it that will answer the purposes of our business—absolutely nothing; and here you go to work and you devise a convenient method of transacting a business which you admittedly do not know how to carry on. There is not a man to-day who is willing to take the record of the aerial lines as a basis for operating, and that is of no mean importance, because the investment of a vast amount of capital and its earnings is based upon the amount of money in those constructions, and you never get any more out of it. You have reached the maximum reward of the investment of your capital. The public has given it to you, and given it to you willingly They say to you: "Your business now, young as it is, is old enough for you to have learned something, and you have brought that business to a point in which it ceased to be a luxury to those who want to use it." The City of New York paid 70 cents without a murmur in the first few years of that business. They declined this year to pay 50 cents. They declined to pay 45 cents, and there are plenty of cities in the country that are paying less than that. They say it is too expensive. Therefore you have got to weigh with great deliberation anything in connection with your business which compels you to increase your prices, or to maintain those you have already established. They put down these ducts; they have occupied the streets, and they have left the companies who shall choose to use them to accomplish that great end of getting something to put in them. Now, I ask the question this morning of Dr. Wheeler, who represents the Subway Commission, what this cost? He does not know. The matter is referred to Mr. Leslie; he does not know; and from all I can learn, nobody has ever taken the trouble to consider the cost of this thing. Now, I want to submit that as a method of doing business. (Applause.) When I go to my people and say, "There is a report; it involves the introduction of new machinery, the addition of a few boilers, the addition of some electrical apparatus that will enable us to do so much business; it will increase our business ten—fifteen—twenty per cent." Do they say, "Go on and do it?" It is just what they want done, but before they do that they ask, "What is that going to cost?"

I do not care if it is a matter of a thousand dollars. Everybody knows an increase of business, particularly in the electric lighting business, is desirable. Does your Board of Direction say go on and do it, without knowing what it is going to cost? No; nobody does it. Individuals do not do it; corporations do not do it, and yet that is the very thing the Subway Commission appear to have done. Look at those drawings; are they submitted to the practical people? If they are, very naturally it will be asked, "What am I going to do with it when I get it?" They cannot answer that question, but they have gone before the authorities of the city who are pressed on all sides to do a very desirable thing. Their plans look very desirable as a piece of engineering. They no doubt are feasible. His Honor the Mayor of this city takes the most sensible view that ever I knew a public officer to take. (Applause.) He is a man who has the courage of his convictions, and it is a great wrong to the electric interests to-day that there are not more of our municipal officers who seem to have the same courage. The Mayor of this city stands in a position which no electric light company dare antagonize. If this Subway Commission brings forward a system and he carries out his intentions of enforcing it, I do not believe there is an electric light interest in the City of New York that dare for a moment antagonize him. Certainly there is not in Philadelphia an electric light interest that would dare to antagonize a municipal officer taking such a position. Now that is a sensible view to take of it. It is a question of dollars and cents as has been many times asserted on this floor. That assertion amounts to naught until the accounts of these dollars and cents is stated. It is a very different thing whether a thing costs a million or costs twenty million dollars. This thing carried on to the extent it is carried on in New York, if I have an appreciation of the subject at all, would ruin every electric light company in the United States and every dollar of capital invested in it would be wiped out. No industry that ever started has sustained itself as this interest has sustained itself since its inception. Gas companies never met with the same obstruction nor did any other public industry. Just as soon as they impressed themselves upon the minds of the public that they were a public necessity, every facility was offered and no obstacle was raised up to make that objectionable, and we are met here with this very fact, as I say, commencing at the wrong end to accomplish something before we know how to accomplish it.

Now, I am just as anxious as any man to have this question of underground wires solved, and I believe every company in the country is willing to do their share of it, and are making the best efforts to do it, but you can readily conceive when you look at the City of New York and note the progress that is being made in it, I mean the substantial progress, that it is not very encouraging to us to go to our companies and ask them to spend money to repeat the same operations that have been made in New York. That is not business. We have a perfect right to benefit and profit by other people's experience. It is one medium of education that we have without paying for. In the City of Philadelphia we have made our effort. It is not expected that the people of Baltimore in the same line of business will go and do just the same thing that we are doing, but every effort has been made in Philadelphia from a straight, square, out and out business stand point from an investment of capital to meet the public demand. I declare here, without fear of contradiction, that it has been an absolute failure, and I consider it a great misfortune to the interests in general that I

am not able to stand here and say definitely why that has been a failure, except on very general principles. But the party that has been endeavoring to make a success of that has had every interest in the world to bring success about, and yet it is a failure and there is no denying it. (Applause.)

Prof. Van der Weyde: Mr. President, our Mayor, notwithstanding he said he did not understand much of the electrical business, gave us the very good advice to devote ourselves to solving that great problem. I have been attempting to solve it for some years. By the way, in Brooklyn, for instance, the subways have been laid down under my sight, as it were. I saw it from time to time—living there. Three years ago they commenced, and what has been the result? They are now pulling out the cables they put in three years ago. Their cables have been found insufficient. If things had been commenced after we had the proper information then such losses would not have happened.

Dr. Moses: Mr. President, I have just received a dispatch which exemplifies better, I think, than almost anything else one of the bursts of eloquence of the Mayor which he gave us yesterday. He said he would like to see electricity really the servant of man for the good of all. This dispatch exemplifies how electricity may come to our aid and bring those who are in sympathy with us, though 3,000 miles away, right within sound of our voices and close enough to touch the cords of our hearts.

"Dr. Moses, Hotel Brunswick,
"New York.

"London, England.—Reckenzaun and friends send greeting to the convention." (Applause.)

Gentlemen, while I am upon the floor, I would like to correct an impression which coming from one of so sound judgment, painstaking, experimental character and experience as Professor Van der Weyde, I would like to correct a statement that he made with which you might otherwise go away too deeply impressed. He says that the subways in Paris have not been used for reasons which would lead you to infer that it is due to the fact of the incompleteness of our knowledge in the distributing of electricity through conduits. That is not the case. The facts of the case are these: The City of Paris and the gas company are in a close partnership. They do not want to have any electric lights there, because one of their chief sources of revenue is gas. We often hear a great deal said about Paris being the representative city for everything that is in advance in science, art and luxury, and we are inclined to say this thing should be developed there. To-day, there are not half a dozen arc lights in Paris outside the Place du Carroussel. The reason is the city found every impediment in the world in the way of electric lighting. It is bound to come though, and those who are deeply interested in the subject in Paris are bringing it about in the following way: A company has been started in Paris, which is seeking rights from the municipality to introduce a system of power throughout the City of Paris. They entirely ignore the uses of it—electric light, transmission of power for motive purpurposes, for electrolysis for all the other uses to which we apply here, are entirely ignored by them, and they propose simply to sell power. Now, when the time comes, of course for the distribution, it is not impossible that the magnificent system of sewers which underlies Paris, may be utilized by any company that may have the right to do it. The right will only be conferred on those who can give guarantees. Those who are introducing the electric light for power purposes in Paris are a syndicate, or rather a company controlled by the House of Rothschild, so that there is every guarantee in the world that when that thing is undertaken it will be done thoroughly, and no doubt successfully.

I am now tempted to refer to something that has been upon my mind for quite a time, and at the end of this discussion I feel inclined to bring it before you—not in the prophetic spirit to which you have been inclined to attribute most of my addresses, but because it seems to be the solution of the distribution of powers in the City of New York, in which, as Dr. Wheeler has said, more business is done in a smaller state than in any other spot on the face of the earth. The Subway Commission have undertaken a great task, and as far as they have gone they have done it as well as the present state of the art will permit.

My friend here speaks of the conduit being a success, but he has not anything to put into it. Why? Because insulation has not been carried to that point of protection where you can say that you have a source of insulation of unlimited light. It is wearing out all the time. Now then we must have a conductor of such character that we can say when it is put down it is never going to be touched; it is a constant source of power, as regular as the sun for its heat, and there it is to be disturbed and changed into any condition that we desire. How is that to be done? Gentlemen, it is done partially for electric lights to-day. You will find conductors, particularly in Pittsburgh, where I saw them very extensively distributed—conductors of very small dimensions going through the streets carrying one or two thousand volts and then being distributed in potentials of fifty volts. I would like the ducts of the Subway Commission built with a series of conductors all electrically connected and having a potential great enough to enable all the force that is necessary to be distributed through this vast metropolis and be permanently there as a source of supply without in any way seriously incommoding our streets. All the current necessary to run all the machinery of the electric light, telegraph, telephone, burglar alarms, and so on, could be carried through a conductor one foot in diameter that could be laid through the streets of New York. It could be so carefully insulated that not one hundred millionth of it would be wasted. It could be made available at any spot in the smallest quantity and in the largest. Let any accident happen to any piece of machinery, and it should not be able to interfere with the enormous power behind it. There must be nothing to interfere with the great current of force that should circulate through the city. That, to my mind, is the beau ideal of the distribution power. Now then, how to do it. We are stumbling upon a thousand difficulties, but I think they can be arranged. You have interests of various kinds—electric lights, power, and so on, all of them running antagonistically. How can they be persuaded that such a system as this is best? Simply by showing to them that they may unite their forces for the furnishing of this power. You cannot put up in any one place a station that would be sufficient to supply the whole of it. It should be like a series of ganglia pumping into this great main artery the power that is necessary. Let them all pool their issues and pump into one station, and from that point let it be distributed, if you please, by the underground commission or by any one who will take charge of it. Let the source of power distribution be the essential feature. It is immaterial to me whether the power is used for lighting or another purpose; power is at the bottom of it, and power should be furnished in the most equitable and most useful way.

Now that is not by any means a utopia. It would enable you in the smallest area to safeguard your current in such a way that it would not be interfered with by any other interest. It should be distributed through all the streets of the city just as water is. It can be done, and in a very much easier way than people imagine. Gentlemen, to my mind, that seems to be a solution of this whole difficulty. Of course for minor distributions that can be very easily accommodated, because between any two blocks you have but a small sub-distribution to make. That can be easily accomplished. Transformers of current can be put everywhere and anywhere, and attached to that main source of supply and measured in the simplest way possible, without any danger. We would have arc lights in houses then. Do not think, gentlemen, that I am trying to derogate from the importance of the arc light interests. People instead of having arc lights in the the streets would be satisfied to bring them into their rooms, if they knew there was no danger. Transform your current from one of two thousand volts into fifty volt currents, and you will find your interest will be tenfold magnified inside of a year. Gentlemen, I have nothing further to say, but give you that to digest. (Applause.)

Mr. DeCamp: The remark of Dr. Moses led me to think that I might have been misunderstood. I believe with Dr. Moses that almost anything is possible. I do not by any means wish to convey the impression that we will not reach this very desirable end. While I do not propose to be a skeptic in this matter, yet on the other hand I do not propose to be an enthusiast. I cannot discuss that question nor will I undertake to discuss it from the point at which Dr. Moses and many other gentlemen in this Association are entirely competent to discuss it. That is not my line of business. I am simply a man in the business who has to look out for the financial interest of my principals. I have got to see that their investment is properly made and reasonably renumerative. The chairman ask me to make some figures, and I submit them, knowing that figures not supported by data are dangerous things to deal in; but I want to submit them and take the risk, depending upon the good judgment of the members of this Association who have experience in that line to believe that I am a conservative in regard to these figures.

$800 a mile rental for the use of conduits—not the furnishing wires and circuits, but simply as a tenant, $800 a mile for a cable or line which cost $500 a mile. Now the gentlemen who framed that schedule must have had in their minds eye a wonderful depreciation to ask more than 100 per cent. on their investment the first year; but admitting that it may be justified by something of which they are the most competent to judge, my experience in the conduct of an electric light station is that it is a pretty difficult thing to distribute more than 50 lights in a circuit of two miles. We do not do it in Philadelphia. But I am going to say two miles for 50 lights. a 1,000 light station under these conditions—I wish somebody would go over this, I am a little doubtful whether my figures are correct.

Mr. T. Carpenter Smith: I would like to ask if that $800 rental refers to the ducts or to a single wire?

Mr. Perry: It was stated that it was a single duct—$1,000 a mile for a single three-inch duct.

Mr. DeCamp: Provided you can use it for general public lighting.

Mr. Smith: Suppose Mr. DeCamp keeps to the conditions that apply to the cable now put in?

Mr. DeCamp: That is a thing in which you might do yourself injustice. I will come to that point before I get through, but take out the general city lighting; that means 200 miles of wire; that means 44 cents a light. Now, to answer the question on the basis on which the gentleman raises the point, it is true that it does not follow that our mileage should be the number of lamps multiplied by two miles, because, certainly, as a matter of economy in rental, we would use the same duct where we could until we got it full. Now, to what extent you could do that is a matter that is only guess work. But I cut it in two—divide it by two if you choose, and pay $80,000 rental a year for a 1,000 light station, and figure out where your dividends would come from. Divide it by four——

Mr. Apgar: May I offer a suggestion here? Could Mr. DeCamp reach the conclusion he seeks—I see what he is after—by ascertaining what it would cost the whole plant with which he is connected, to put that whole plant in the ducts furnished from $550 per mile per year to $1,000 per mile per year. He knows how many miles he has in circuit, and he can determine what would be the annual expense for rental by placing all of these wires in ducts. You could reach that quite readily could you not?

Mr. DeCamp: No, I should not do that quite readily by any means. If I was going to put our wires in a conduit for which I was paying $800 a mile rent, I would do it in a very different way from what I am now doing it.

The President: On this basis the gentleman means.

Mr. DeCamp: Anybody who has had experience in distributing light for a central station knows that his first calculation of the first cost is apt to be deceptive. Now we run wires from our central station, not with the view of supplying the particular lights we may run it for at first, but we run it over a district, if we have the privilege and opportunity of doing it, by which we think we can utilize that wire to the best advantage. In other words, we might go to get ten lights in a direct line of a mile, if the ten lights were our only object. Very probably we would choose to put out five miles of wire over a territory from which we would draw other business. Therefore, for me to make a statement on the basis of the wires we have got, would be more uncertain than the figures I have already stated.

Mr. Smith: Mr. President and gentlemen, Mr. DeCamp has made one statement which I think is entirely right—that this question of undeground wires has been taken out at the wrong end, but I do not agree with him as to the way in which it has been begun at the wrong end. I maintain it has been taken at the wrong end, because the men who have been getting these various reports on underground wires are the men most directly interested in underground wires not being a success.

We are told over and over again of the failure of the underground system, and it reminds me of the old story of the man who had stolen the cow and one person was produced who saw him do it, and he replied that he could not bring forward twenty men who seen him do it. Now, I maintain that in a case of this kind, one good instance of successful work is worth forty instances of bad work. When Mr. De Camp states that there is no successful underground work in Philadelphia, I think he must have forgotten what I told him in Pittsburgh, that I had 15 miles of wire running underground in Philadelphia. We supply eight newspapers—and they are hard to please. We use 1,000 volts of the alternating current. I have laid between five and six miles of underground work. It costs about $7,000 a mile, not including the the cables to be drawn in.

Now if we start with the idea that you must not have your conductors buried—the actual metal required buried at once—it seems to me that the only thing you can use is a conduit that will allow you to increase by drawing in cables. We know what a conduit will cost. The greatest expense in a conduit is the trench and the repairing of the street afterwards. That would amount to anywhere from 35 to 40 per cent. of the total cost. If you put down a conduit into which you can draw additional cables afterwards you are saving as much as possible of the original expense; not only that, but you are getting rid of the greatest opposition to the underground system—the objection of of the citizens to having the streets torn up.

President Duncan here asked Dr. Wheeler some pointed questions concerning the costs of the New York conduit.

Dr. Wheeler: I would say that I think there is no question about the fact that putting wires underground is a matter of considerable expense. I did not attempt to give the explanation in my paper, because there is no doubt about that fact, and as to the inquiry as to what the expense is Mr. De Camp says I replied I did not know, and Mr. Leslie replied he did not know. What I did say was that Mr. Leslie was the proper man to answer that question, and I think that Mr. Leslie said that the proper way to obtain an answer to it was individually to make that inquiry at the office of the company. I do not think it is correct to state that Mr. Leslie and I said we did not know what the cost was.

In reply to Mr. Lynch, Dr. Wheeler said the subway commission was using an iron pipe covered by hydraulic cement. Mr. Lynch wanted to know if any other city was using pipes.

Dr. Wheeler: Yes, they are using them in Chicago. In Chicago they had a conduit made of creosoted wooden tubes in which they tried some arc light wire. The arc light wire set fire to the conduit, and they tried to put out the fire with chemical engines. That did not succeed and they squirted water into it from a steam fire engine, and kept that up for about a week. They found they could not put the fire out apparently.

Mr. Lynch: How long has this conduit been in use in Chicago?

Dr. Wheeler: Excuse me until I finish. They took that conduit out and replaced it, I understand, with iron tubes laid in hydraulic cement.

Mr. Lynch: How long has the iron conduit been used there?

Dr. Wheeler: I do not know exactly when that was put in.

Mr. Sunny, of Chicago: We put down the Dorsett conduit about seven years ago. We took out the creosoted wood conduit, which was put in about two years ago, after it caught fire, and put in iron pipes—about 105 feet of it. There are no manholes. The telephone people have a system of iron pipes in cement—same as is being put down in New York.

Mr. Lynch: Has this Johnstone patent, recommended by the Subway Commission for supplementary batteries, been in operation in this country?

Dr. Wheeler: That has been in operation in Philadelphia and Chicago.

Mr. Lynch: But as I understand, Mr. DeCamp, there are no electric wires in it at all?

Mr. DeCamp: It is used now for an incandescent station. The arc light business was abandoned about a year and a half ago.

Mr. Lynch: Those are the only two places. This system adopted in New York is in use, 105 feet, for electric lighting in Chicago; the same kind of conduits as now used in New York, wrought iron pipe surrounded by hydraulic cement.

Mr. Sunny: Well, I ought to state in addition to that, as to the section of 105 feet, that at all the street crossings where we wish to cross it is all in iron pipes. In Chicago the sidewalks are all hollow, which is quite an advantage, and makes local distribution very simple. Chicago is the only city, probably, so fortunately situated. All the lighting business is done through underground wires. We have about 32 circuits, carrying 1,200 lamps. Have had four cases of trouble in the large cables. It cost us about $1,500 for putting in one circuit for two miles, one mile out and back. If these cables last five years, we will have paid in rent, $3,330; for original cable, $1,500; a total of $4,830, which is $20 per year per lamp.

Mr. DeCamp: I consider four grounds on an underground cable equal to 400 on an aerial system, because it is a matter of a few moments on the latter.

Mr. Sunny described at some length his experience with cables, as mentioned in Mr. Acheson's paper. In response to a query from Mr. Weeks, Mr. Sunny said that in changing the cables first put down cost the company $50,000, not counting loss of service, reputation, etc. The first cables were in but a short time before they failed.

Mr. Law: We think, in Philadelphia, that it is a pretty serious matter to have a ground

appear on a circuit of 50 lights. It is difficult to find, and difficult to remedy. I have had to make three or four cuts to find a single ground.

The President: Gentlemen, the chair has given the widest latitude to this discussion, realizing that not only the gentlemen present, but the people they represent are vitally interested in this question, and not only they, but the public at large also, and the discussion this afternoon has been profitable in this respect. It has developed the fact that while in Chicago and in New York City and in Pittsburgh, Philadelphia and other cities they have claimed that there has been no progress and no effort made by the electric light companies to solve this question, yet it has been demonstrated that these companies, individually, working alone from their different standpoints, have each taken up this question and have attempted to solve it for themselves. They have not only done that but they have communicated one with another and obtained the best information they could.

This discussion has developed the fact that the gentlemen here in New York are going ahead with the best knowledge and the best intelligence they have at their command, and they ask us, as a representative body of men, to start in and aid them as a body. We have never done that hitherto, but you, gentlemen, in your resolution to-day, have provided for the continuance of the Committee on the Insulation of Plant, and you have a vast amount of practical knowledge, as reported by Dr. Moses, to be collated and to be given to these manufacturers, and not only improve the condition of insulation but improvement of the wire itself. You have gone further; you have provided for a committee of five which shall collect data with respect to insulation from time to time and report at the next convention six months hence what has actually been done, what are the practical results, what has been the cost, what is it going to cost, so far as they can find out. I say we are in the right direction. That leads up to another thing in my mind. It shows that you will need a permanent office somewhere where you can get this information, where it can be furnished not only to the members of the Association but to the outside public and to municipalities and others who are clamoring for every one to go under ground.

I will make one or two announcements. The first is that I shall appoint Prof. Liebig, of Baltimore, in place of Prof. Thomson on the Committee on Insulation and Installation of Plants. I want to say gentlemen just here that instead of members thinking it is no honor to be put on a committee of this kind, as might be inferred from the action of the committee hitherto in simply reporting progress, that I should regard this as one of the highest honors that can be conferred on any member, and at the next meeting we will demand a report in writing from the committee or know why they do not furnish it.

Mr. T. Carpenter Smith: I wish to make an explanation to the members of the Convention. In a letter which I wrote to a gentleman in this city which was afterwards read to the Board of Electrical Control I made the statement that the inspector of lights in Chicago had shown a discharge from a magnet as an instance of an alternating current. I made that statement on the authority of a newspaper report of a lecture that he delivered. I received a letter from Mr. C. C. Haskins subsequently imploring me not to put him down as an electrical idiot. I expected to meet him at this Convention when it was my intention to make a personal apology to him. But he is not here and I know of no other way than to make my apology in the presence of this Convention. I withdraw the statement then in the presence of this Association.

FRIDAY'S PROCEEDINGS.

ONLY ONE SESSION.

President Duncan called the Convention to order at 10 A.M., and said: The transportation committee had made a great effort to secure reduced rates to the Convention, but the railroads refused. One and a-half fare is promised if the next Convention is held west of Pittsburgh.

On motion, Messrs. Geo. F. Porter, of Philadelphia, M. W. Mead of Pittsburgh, and F. E. Degenhart, of Chicago, were appointed a committee on transportation.

Mr. Ridlon made a report of the committee on insurance, and spoke of the Electric Exchange of Boston and its work which we described in the REVIEW last week.

On motion of Mr. DeCamp, the committee was continued to report additional facts at next meeting, and President Alexander and Secretary Cram of the New England Electric Exchange were added to the committee.

The President: I appoint Messrs. E. T. Lynch, Jr., C. H. Barney, H. Crocker, E. H. Davis, and Walter C. Kerr the committee to obtain practical information in regard to the underground question.

On motion of Mr. Arthur Steuart, the following was adopted:

Resolved: That the National Electric Light Association, after a full discussion of the subject, desire to express their hearty sympathy with the views expressed by his Honor Mayor Hewitt in his address before the association upon the subject of putting wires underground; and in addition desire to take the opportunity of expressing the opinion that up to the present time no commercially practicable method has been brought to their notice by which high tension direct currents such as are used for arc lighting can be placed underground.

On motion of Mr. Garratt the committee appointed to name the place for the next meeting was authorized to recommend the names of a new executive committee as provided for by the new Constitution.

Mr. Steuart then read Professor Van der Weyde's paper which we publish in the ELECTRICAL REVIEW SUPPLEMENT.

Dr. Moses: We have been sitting here as a sort of mutual admiration society, taking in all the compliments, well meant and many of them true, of so wise a man as Mayor Hewitt, and we feel a certain glow of satisfaction which would almost lead us to take our intellectual pocket books out and offer them to the world free of charge. But, gentlemen, something has transpired to-day which I think ought to be called to your attention so as to awaken you from your lethargy, and I will read a passage from a letter in which a key-note of attack is sounded which I think we ought to reach with serried ranks. This is a letter from ex-Governor Cornell to Mayor Hewitt. I quote it as printed in one of the daily papers, and I am told it is the entire letter, with the exception of five unimportant lines.

"The disposition of electrical wires in such manner as to abate their dangerous qualities and at the same time to preserve their useful features, is a question demanding serious thought and urgent remedy. It has long vainly sought solution, and you are the man who can apply the true and only available corrective. The only remedy now practicable for removing the danger of high tension circuits which presently menace the life and property of our citizens is to absolutely prohibit their use within the city, the strong arm of the State by legislative enactment and honest executive administration of such law positively prohibiting the use of wires bearing the high tension circuits will give us safety. Nothing else can so quickly and surely accomplish it. Will you help us to this result?

The President: I would like to know if ex-Governor Cornell writes that letter as an expert, or as a representative of the Western Union Telegraph Company or some other company, or some other interest.

Mr. Moses: We all know that ex-Governor Cornell is largely interested in the Western Union. We also know his ability and his great influence, and when such a man speaks we must listen and reply. I have prepared a set of resolutions that I think this National Electric Light Association ought to promulgate for their own safety, recollecting the fable in Æsop where the bulls, when they kept together, could keep off the lion, but the instant they separated they were devoured by him. The effort is made to destroy one of the important interests which it is the duty of this Association to foster. I call your attention to it and warn you. Gentleman, this is the resolution:

WHEREAS, The National Electric Light Association view with some uneasiness the persistent efforts of rival interests to educate the public to aid distrust of high potential electric currents;

AND WHEREAS, They would protest with all energy against recent efforts to pit against each other the continuous and alternate current systems of electrical distribution, which efforts had as their covert purpose the destruction of the harmony of action now existing between them;

AND WHEREAS, This Association, for mutual protection, recognize distinctly the danger of unfair legislation such as has destroyed the electric light interests of Great Britain (Applause);

Therefore, be it resolved, that the National Electric Light Association emphatically declare that it is beyond a doubt possible to produce and distribute high tension currents for public use without any more danger or difficulty than attends the distribution of gas and water in our dwelling.

And, further, be it resolved, That they would impress all legislators with the fact that success in the electric light and power business is based chiefly upon economy in the size of the distributing conductors, and that to utilize this fact high tension currents were adopted in the first stages of development of electric lighting and have been used ever since and will continue to be used; and, further

Be it resolved, That it is our conviction that there is no difference in the dangers attending the use of continuous or alternating currents and that both may be so transformed before being used as to render them a perfectly harmless and practical means of distributing electric power for use in cities.

The resolutions were unanimously adopted.

Dr. Liebig then read his paper, which appears in the REVIEW SUPPLEMENT.

The paper was discussed, and then Mr. Arthur Steuart reported from the Committee on Patent Legislature, and gave a summary of the bill which had been introduced in Congress to appoint a Court of Patent Appeals. The bill contemplates a court of five judges, and has been published in full in these columns.

Many compliments were bestowed on Mr. Steuart for his untiring work by Messrs. Duncan, Weeks, Foote, and others, and it was voted to continue the committee and authorize the treasurer of the Association to open a book for voluntary subscriptions for carrying on the work.

Mr. E. R. Weeks then read his interesting paper on "Electrical Education," which we shall publish, with the discussion, subsequently; also, we shall publish Mr. Lufkin's interesting paper, with the discussion, subsequently.

The special committee, through Chairman C. A. Brown, reported, recommending Chicago as the next meeting place, and also the following named gentlemen as members of the Executive Committee:

B. E. Sunny, Chairman, Chicago.
S. A. Barton, Chicago.
O. A. Moses, New York.
J. F. Morrison, Baltimore.
W. A. Kreidler, Chicago.
E. F. Peck, Brooklyn.
E. T. Lynch, Jr., New York.
T. C. Smith, Philadelphia.
Frank Ridlon, Boston.

On motion the report was accepted and the secretary instructed to cast the ballot of the Association in favor of the officers named.

Mr. Arthur Steuart: I am instructed by the Committee on the President's recommendations of which I have the honor to be Chairman to make the following report: There is but one subject contained in these recommendations that has not already been disposed of by the Convention, and that is the question of establishing a permanent office for the Association. Ever since the organization of the Association a need has been felt for some permanent officer who would be in a position to gather up all the threads of the Association's work and bring them to a practical focus. Collect and collate information needed by the members and not furnished by the reports of the Convention and have this information ready for the use of members when needed. It has not heretofore been thought best to undertake this work, but your Committee after careful consideration agree with the President in thinking that the time has come for the establishment of such an office. They also think that the officer proposed should be a person thoroughly familiar with the field of electric lighting and kindred subjects, and that his office should be located in the City of New York, and be furnished with such a collection of books and magazines as would enable him to keep himself abreast of the development of the science and the industry. The Committee therefore recommend that a resolution be adopted by the Convention to the effect that the Association have a permanent location in the City of New York and that the position of Secretary and Treasurer of the Association be held by an expert electrical engineer and they recommend that the President at once take steps to nominate a suitable person for this position and select a suitable location in this city for a central office.

The Committee, which was composed of Messrs. Arthur Steuart, Edwin R. Weeks, A. F. Mason, Henry D. Stanley, submitted the following resolution:

Resolved, That this Association shall hereafter have permanent office in the City of New York, which shall be in charge of an expert electrical engineer who shall be the Secretary and Treasurer of the Association and that the President at once take steps to procure the services of such a person and establish him in suitable quarters and with suitable facilities in this city.

Mr. Phelps: I move the adoption of the report. The motion prevailed.

Dr. Moses: It seems to me, in connection with that report, that we ought to take into consideration the valuable service of the Secretary, and before that resolution is offered I would propose a substitute for it, or at least an antecedent resolution in which Mr. Harding's services shall be properly recognized by the Association. If the stenographer will take the resolution down I will dictate it. As we have been faithfully served by Mr. Harding, I think it that he should receive some recognition from us for that in the way of a vote of thanks and appreciation in this Convention. I therefore move that the appreciative thanks of this Association be tendered through the President to Mr. Harding of Baltimore for the zealous manner in which he has performed the functions of his office, the care that he has taken to have everything in the way of records properly prepared, and that we congratulate ourselves upon having had a secretary, our first salaried officer, so efficient a one as Mr. Harding.—Adopted.

The request of Mr. Foote, asking that an expert visit the Cincinnati Exposition on behalf of the Association, did not meet with favor, it being stated that it was getting too late to take up new matter.

Mr. DeCamp offered the following resolution, which was adopted:

WHEREAS, The value of capital is determined by the profits realized thereon,

WHEREAS The risk attending the business of electric lighting make it pre-eminently necessary that its capital be surrounded with such safeguards as will protect it against illegitimate competition,

WHEREAS, The practice of parent companies of furnishing apparatus and capital for the establishment of plants in cities and towns where local capital has already been invested is a growing evil; therefore be it

Resolved, That this Association denounce such practice as detrimental to a common interest, and recommend its members jointly and individually to suppress it, even to the extent of discriminating against all systems which persist in such practices.

The chair appointed the following Committee on Education, to report at the next meeting: Dr. Moses, E. R. Weeks, and A. R. Foote.

The Convention, upon motion of Dr. Moses, adjourned, to meet at the Electric Club at 3 o'clock. The proceedings at the Club appear elsewhere.

Dinner to the Executive Committee at the Electric Club.

The handsome parlor dining room of the Electric Club was devoted to extending courtesies to the officers and Executive Committee of the National Electric Light Association, Tuesday evening, August 30th. In addition, Mr. H. C. Davis, Mr. Leonard E. Curtis, Mr. Erastus Wiman, Mr. E. R. Shipman, and Mr. C. J. Judson were present as guests, the ELECTRICAL REVIEW having the honor of giving the dinner. Brief addresses were made by the gentlemen, and the REVIEW and its staff would most sincerely express their appreciation of the many kind words spoken, feeling, however, that they were undeserved. The speakers were Dr. Moses, Mr. Wiman, Mr. Shipman, Mr. E. R. Weeks, Mr. Curtis, Mr. Davis, Mr. T. C. Smith, Mr. S. A. Duncan, and Messrs. Frank Ridlon, E. F. Peck, A. V. Garratt, Eugene T. Lynch, W. L. Candee, H. D. Stanley, W. H. Landon. Mr. Curtis and Mr. Wiman spoke quite eloquently, the latter expressing his great appreciation of the marvelous growth of the electrical industry, and the former expressing his opinion that there should be no close, narrow monopoly of electric lighting, but that all the different companies should work in common for the advance of this great power.

The Electric Club again covered itself with high honor in the dinner management, and may now be recognized as one of the best of clubs in New York in this respect.

Wednesday evening, this journal had the pleasure of having the delegates to the number of 230 attend, as its guests, the famous spectacle of the "Fall of Rome." Mr. Erastus Wiman was present, and at the close of the performance gave most kindly greeting to the visitors to Staten Island (for which he has done so much), and thus kindly assisted in making the evening a very pleasant one.

The Allegheny Electric Plant to be Rebuilt.

The Allegheny County Light Company plant, on East Diamond street, Allegheny, is to be replaced by a new brick structure as large as the one in Virgin alley. The two small dynamos now in use are to be removed and replaced by two 65-arc light dynamos. These will shortly be increased by other arc dynamos. The plant has now a capacity of 2,200 incandescent lights. Next week there will be ready for operation five 2,500-lights Westinghouse alternating machines or dynamos, operated by five Westinghouse automatic engines of 250-horse power each. The present battery of boilers, 200-horse power each, to be increased by one battery of two boilers, 400-horse power each, another of two boilers of Babcock and Wilson make, 300-horse power each, and the two boilers which were formerly of the South Side plant, with a capacity of 250-horse power each. The new switch board will be the finest in the country.

ELECTRICAL PATENTS

(Copies of any Patents in the following List will be sent to any address on receipt of twenty-five cents.)

INDEX OF INVENTIONS FOR WHICH LETTERS PATENT OF THE UNITED STATES WERE GRANTED IN THE WEEK ENDING AUGUST 26, 1888.

388,430 Galvanic Battery; Abraham V. Meserole, New York, N. Y.

388,438 Circuit changing devise for burglar alarms; Frank H. Nutter, Malden, Mass.

388,442 Underground electric conduit; Edward H. Phipps, New Haven, Conn.

333,454 Electric resistance measuring apparatus; Charles E. Scribner, Chicago, Ills., assignor to the Western Electric Co., same place.

388,477 Electrical conductor; William A. Conner, Pittsburgh, Pa.

388,481 Telegraphy; Patrick B. Delany, New York, N. Y.

388,482 Dental electric apparatus; Charles A Eizenhart, York, Pa.

388,487 Suspending overhead electric wires; Alfred E. Harris, London, England.

388,505 Thermal circuit closer for fire alarms; Henri S. Pettit and Henry S. Bresson, Vitoria, Spain.

388,512 Electric motor; Jean T. van Gestel New York, N. Y., assignor to the Van Gestel Manufacturing Company, of New York.

388,513 Commutator for dynamo electric machines.

388,514 Electric tram car.

388,583 Electric meter; Karl Raab, Kaiserslautern, Bavaria, Germany.

388,592 Ice or refrigerating machine; John E, Siebel, Chicago, Ills.

388,594 Electric arc lamp; Lewis W. Spencer-Hoosick Falls, and Frederick P. Jaquitt, Hoosick N. Y.

388,601 Electrode for secondary batteries; Sylvanus L. Trippe, St. Louis, Mo.

388,622 Electric motor for self-winding clocks, Frank W. Brainerd, Chicago, Ills.

388,631 Electric fire alarm signal box; Sidney A. Chase, Evart, Mich.

388,645 Apparatus for hardening and tempering by electricity; Phillip Diehl, Elizabeth, N. J.

388,656 Wire rope or cable; Henry W. Farley Urbana, Ills.

388,668 Storage battery plate; Charles D. P. Gibson, New York, N. Y.

388,690 Electric railway station indicator; George H. Kirwan, Wilkes-Barre, Pa.

388,697 Arc lamp; John Lea, London, England, assignor to Hugh Watt, same place.

388,707 Electric meter; Henry G. Morris, Philadelphia, Pa., assignor to Grove Electric Company, same place.

388,723 Electric arc light support; Benjamin Schardt and George Jones, Dayton, Ohio, assignors of one-third to John R. Fletcher, same place.

388,746 Electrode for storage batteries; Jean T. van Gestel, New York, N. Y.

388,753 Electric motor; John Batley, Philadelphia, Pa.

388,791 Switchboard for telephone exchanges; Charles E. Scribner, Chicago, Ills., assignor to the Western Electric Company, same place.

388,803 Railway telegraphy; Granville F. Woods, Cincinnati, Ohio.

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THE VIRGINIA ELECTRIC LIGHT & POWER COMPANY, OF RICHMOND, VA.
NEW YORK OFFICE, 63 WALL STREET.
New York, August 21st, 1888.

A. F. MASON, Esq.,
SIMPLEX ELECTRICAL CO.,
Boston, Mass.

Dear Sir:
I have been using the Simplex Wire on a large portion of our lines in Richmond, Va., for the past five months. I have taken daily tests of the insulation during that time. The longest single circuit I have is about five miles, and at no time has the insulation test ever been less than one megohm. I cannot speak too highly of the wire or its insulation. A large portion of it has been run through foliage and trees in the streets, and upon examination a few days ago I failed to find any place where the wire has been abraded by coming into contract with the branches of trees. My instrument does not measure over one meghom, and I cannot tell how much higher the insulation may have measured. One megohm on wires in circuit is enough for me.

Yours very truly,
W. H. COLE, *Superintendent.*

THOMSON-HOUSTON ELECTRIC CO.,
AUGUSTA, GA.
August 12th, 1888.

Dr. A. F. MASON,
SIMPLEX ELECTRICAL COMPANY,
328 Washington St., Boston, Mass.

Dear Sir:
We are using in our arc-lighting circuits about twenty (20) miles of your Simplex T. Z. R. wire.
We have feund the insulation a most perfect protection against moisture and the abrasion of small tree limbs.
Have used your wire in our station, for running through trees, on buildings and porches, under mouldings, etc., and through cellars, and we have never been able to discover a "ground" upon any circuit since our plant was put into operation.

Very truly yours,
JOHN H. WATERMAN.

ADDRESS,
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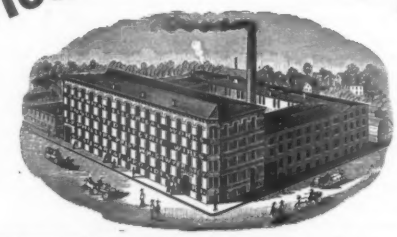
328 WASHINGTON STREET, BOSTON, MASS.

EUGENE F. PHILLIPS, PRESIDENT.
W. H. SAWYER, SEC'Y AND ELECTRICIAN.

American Electrical Works



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THOMAS I. SCOVILL, NEW YORK AGENT.

SUPPLEMENT

To the ELECTRICAL REVIEW, September 8, 1888, Containing a Number of Papers Read Before the National Electric Light Association, August 29th, 30th and 31st, 1888.

The Comparative Danger of Alternate vs. Direct Currents.

PAPER READ BY P. H. VAN DER WEYDE, M. D.

It is only a few days ago that I received the flattering invitation to appear before this meeting of the most eminent electricians of the United States, and present a paper containing my conclusions about the comparative danger to life lurking in the alternate and direct dynamo currents. I do so readily, as I have lately had the opportunity to become acquainted with the arguments made at both sides of the question. I was not prepared to do so when, a few months ago, I attended a meeting of the New York Board of Electric Control, where several papers were read, most of them in opposition to Mr. Harold P. Brown, who had expressed himself in opposition to the use of the alternate current system, of which the introduction has lately been commenced. When the president of that meeting asked me to express my opinion I was in the necessity to decline, stating that my appearance there was solely intended to listen to arguments upon the subject about which I desired full information.

As some of the papers read there were written in such a spirit as to compel Mr. Brown to defend himself, I made up my mind to attend his expected defense, especially as it might give me an opportunity to hear what powerful arguments and facts would be brought out by the person who has put himself forward as the champion of the enemies of the alternate current system.

It makes always a painful impression upon me when I see that a scientific investigator feels the necessity to defend himself against personal attacks. The calling of the scientist should simply be confined to ascertain what is the truth; if he thinks to detect erroneous conclusions arrived at by any co-laborer, it is his duty to expose them. At the same time he must mind the old rule, *suaviter in modo, fortiter in re;* therefore, above all, he must let the facts speak for themselves, avoiding any allusion regarding the capability or ulterior motives of his antagonist; in short, he must leave the use of all personalities to the politicians; for these the main considerations are *persons, principles* are secondary and may be changed to suit circumstances, or thrown overboard entirely. In science, however, we have to the contrary nothing to do with *persons*, but only with the ultimate *truth*, which we all are striving to arrive at.

At a recent visit to the physical lecture room of Columbia College, where I had been invited by telegram to hear the reading of a paper, and a lecture illustrated by experiments by Mr. Harold P. Brown, the feeling referred to above was more painful to me than even the howling of the dog which was experimented upon. Dogs have for so many years been considered as the poor legitimate martyrs of science, especially under the hands of physicians and professors of physiology, that we have become more or less hardened in their regard. Nobody will deny the immense value of the increase of our biological and especially pathological knowledge obtained in this way.

A great portion of the paper read by Mr. Brown consisted in complaints about the personal attacks made upon his capability, as soon as he asserted in print that the alternate electric currents were more dangerous to human life than the direct currents, namely: that a current of the electro-motive force of say 300 volts, alternate current, would be more likely to destroy life than double or triple that strength of a direct current.

One feature was prominent in the reading of the paper as well as in the lecture and experiments; it was evident that the purpose was not so much to exhibit what was the truth in the matter, than to show that he was right in what he had asserted.

He attempted to prove this by experimenting upon a large dog, which, when subjected to a direct current, stated to be 300 volts, set up a short howl; 600 volts produced a longer howl and frantic efforts to escape from the cage, while a current of some 900 volts paralyzed the dog, who kept up a labored breathing. Then a representative of the New York Society for the Prevention of Cruelty to Animals interfered, and forbade further trials of this kind, so that Mr. Brown was compelled to give the dog the *coup de grace* by applying the alternate current which he said to be of the strength of only 300 volts.

Unfortunately for Mr. Brown this proved nothing, as the dog was already half dead by the previous successive and increasing direct current doses of 300, 600, and 900 volts respectively. Another dose of 300 or 600 volts direct current might in all probability have ended his life just as well. But what is more, his statement that the alternating current was merely 300 volts was not proved, as he himself had stated previously that reliable instruments for measuring alternate currents were difficult to obtain, and confessed that he had only a voltmeter for this purpose but no am meter. After the lecture I examined the voltmeter and found that according to the statements of Mr. Brown, himself, its operation was based upon indications of rise in temperature.

Now, it is well-known that voltmeters based on this principle are based on false premises; rise of temperature is not produced by electro-motive force, but by amount of current; one Wollaston plunge battery cell, of one square meter acting surface, having, of course, the electro-motive force of only one single volt, will produce far more heat than a series of 24 freshly prepared cups of a Leclanche battery of 40 volts electro-motive force. This pretended voltmeter was in fact a kind of ammeter.

This is so self-evident that Prof. G. Forbes from England, who last year exhibited to the Society of Electrical Engineers in New York a meter for alternate currents, did not think of calling it a voltmeter, because its operation was also based upon rise of temperature, but he called it a currentmeter. This meter was described and illustrated on page 1 of the ELECTRICAL REVIEW for October, 8, 1887, where there is added a little table giving the observed currents in amperes. Immediately under that table follows the statement that Sir William Thompson complimented the author on having practically solved a problem on which he himself had been working without satisfactory results, thus endorsing the instrument as a current or ampere meter.

This shows that Mr. Brown was mistaken when he said he had no ammeter for alternating currents; he had one and supposed it to be a voltmeter; if he used it as such, what becomes of his statement that the alternate current he used was 300 volts.

And here I cannot let the opportunity pass by to repeat what I have been preaching for years, namely, that the voltage alone is no criterion in regard to the dangerousness of a current; the danger comes only when the electro-motive force (as measured in volts) is accompanied by a sufficient quantity or volume of current (as measured in amperes). An electro-motive force carrying a current of only a few micro-amperes, may be as high as 1,000 volts without doing any harm (even when alternating, as proved by the Ruhmkorff coil). It behaves like water oozing out of a pinhole under a pressure of hundreds of pounds; it can do little or no work. At the other side, a very large volume or quantity of current with small electro-motive force, of say a small fraction of a volt, will not have the power to pass through the human skin, or even not through the liquids of the body, but only through metals (as proved by the thermo-electric pile). Such currents behave like a large volume of water in a lake, with little or no inducement to make it move, also this will do little or no work.

Prof. Mayer of the Stevens Institute, Hoboken, in a lecture recently given to the members of the electric section of the American Institute, exhibited some novel experiments intended to measure if possible the voltage of static currents. He used an old fashioned friction electric machine, and showed that the voltage of its currents ran into the thousands, while the amperes were so minute as to escape the possibility of measurement, with the means thus far at disposal.

This leads me back to the subject of the experiments of Mr. Brown; he stated that the quantity of the direct current he used was only a fraction of one ampere. This induced me to examine also the ammeter after the lecture, when I found that the ammeter and voltmeter were coupled together in series in the same single circuit. Now every experienced electrician knows that in order to measure the capacity of a dynamo current in amperes, we must not place any other resistance in the circuit, much less the high resistance of a voltmeter which may be 500 ohms, as then the indication of the ammeter may drop down 90 per cent. of the original indication; in fact the ammeter indicated actually two-thirds of an ampere as had been stated by Mr. Brown when he was asked during the lecture.

The manner in which the ammeter and voltmeter was used was considered by me in connection with the fact that, if really a current of only two-thirds of an ampere had been obtained, it would render the dynamical value of the three currents used only equal to 200, 400, and 600 watts respectively, which was incompatible with their effect on the dog. This caused me to go to the dynamo plant of Columbia College to inquire. I found that the direct current machine used was an Edison municipal dynamo of 15 amperes and 1,200 volts.

It is likely that Mr. Edison gave it the name of municipal in anticipation of the fact that the municipal governments will need such machines when the new law in regard to capital punishment and of despatching criminals by electricity instead of hanging goes in operation next year. If so, it is very suggestive, in regard to the controversy we are discussing, that such an able electrician as Mr. Edison is satisfied that a direct current dynamo is all that is needed for that purpose without regard to the alleged greater effectiveness in this respect of the alternate current dynamos.

This dynamo did not belong to the Columbia College plant, but it was furnished by Mr. Edison for the occasion, as well as an alternate current dynamo. Both were removed after Mr. Brown finished his experiments, which it appears he continued privately for a few days after the lecture.

One of the dynamos used belonged to the college plant; it was an incandescent light dynamo, of which the capacity was stated by the engineer to be 125 amperes and 110 volts. This dynamo was employed to obtain the alternate currents, by using it to feed the field magnets of a Siemens-Halske alternate current machine, after the usual manner, as represented in the engraving exhibited here, which shows the essentials of the arrangement used, only with this difference, that the field magnets of the Siemens alternating machine were supplied by the direct currents obtained from the much larger 125 ampere dynamo referred to, in place of the small one represented in the engraving, at the right hand side below.

The kind of apparatus which was used and the nature of their arrangement, for the production of the alternate current, makes it very unlikely that it would produce a current of only 300 volts. Especially when we take in consideration that the current developed must represent some kind of equivalent for the horse-power required. Firstly, to drive the 125 ampere incandescent light dynamo, next that required to drive the alternate current dynamo; the latter must have consumed considerable power, as the 125 ampere current was more than sufficient to saturate its great number of its stationary electro magnets. According to the statement of the engineer, the engine driving the 125 ampere dynamo require 36 h. p., that of the alternate dynamo, 36 h. p.; together, 72 h. p., which, at 746 watts per h. p., gives 53.712 watts. If the amperes of such a current had been measured after the method employed by Mr. Brown for the direct current, it would have resulted in 53.712 divided by two-thirds of an ampere, or 80.568 volts.

Of course, this is an exaggerated estimate, but sufficient to show the worthlessness of all the figures as given by Mr. Brown. In order to come to correct conclusions it would be necessary to measure, by means of indicator diagrams, the engine power utilized, and measure the currents obtained by proper instruments, properly used and conscientiously observed.

One thing is certain, namely, that the dynamos used were not of such a defective quality as to warrant the supposition of such an enormous loss of the power applied as would be the case if only an electro-motive force of 300 volts had been obtained.

I must also not omit here to state that if Mr. Brown had known the proper quarters where to apply for apparatus to determine properly the voltage and amperes of alternate currents, he could have been provided, and his labors in this direction might have had some value.

There was added on the lecture room table another important additional (however small) contrivance, for the right understanding and use of which I will have to make a short introductory explanation. I do this also because I have been especially requested to do so, by several parties who had become interested in the operation of this, to them, very novel device.

I must ask pardon to bring some elementary considerations before this learned body, but my apology is that this paper will be published and read by many who are not so well informed about electrical subjects, and whose ideas upon it need some clearing up.

Every one who has handled faucets attached to pipes from which water can escape under pressure, will have noticed that when suddenly shutting off the water, a blow like that of a hammer is produced in the pipes. This is caused by the momentum of the water when in motion (often very improperly called inertia), and which shows itself every time this motion is arrested. On this peculiarity is based a contrivance in which, by the automatic alternate opening and closing of a valve, a small portion of the water discharged may be raised to a greater height than that of the original device which produced the pressure. This contrivance has been called a hydraulic ram, and by its help an increase of pressure may be obtained at the expense of a certain quantity of water.

Notwithstanding electricity is not a fluid like water, it behaves, however, also in this case, in a similar manner; at the moment a uniform electric current is suddenly interrupted, a current of greater electro-motive force (more pressure) is developed in the conductor, and will show itself as a spark at the break of contact, and as a shock through the body when the hands have hold of the wires when the contact is broken. It is a very old observation, and one of the earliest reminiscences of my boyhood (about 1823), that the current of a column of volta of say 30 pairs of plates, scarcely perceptible when closing the circuit through the body, will give a quite sensible shock when breaking the circuit. Such currents have been called extra currents, and they are, of course stronger in proportion to the strength of the original current, and still further increased

by inductive influences when there are coils in the circuit.

As it may be desirable for special purposes to eliminate these currents, an apparatus has been invented, which operates like a very sensitive relay, and then leaves these extra currents off, or shunts them in another channel after the manner of lightning protectors. Such an apparatus was on the table during the experiments with the dog, and appeared to be intended to protect the animal against the effect of these extra currents. I must confess not to see why this was done, except for the purpose to annul the most powerful and most dangerous item connected with the direct currents. Therefore, I consider the addition of the contrivance improper if we wish to arrive at the truth in regard to the comparative danger of the alternate and direct currents, because in case of accidental exposure of person, there is rarely such a safeguard enclosed in the circuit, and the person struck by the current must submit to the extra current as well.

In order to arrive at the truth of the matter we must also, above all, be able to make definite statements about the voltage and the volume of current, based on precise measurements, which, in regard to the alternate currents, could not be furnished but was only guessed at.

Finally, as far as I can judge about the matter, guided by the present state of knowledge (especially in regard to some, in many respects, still unexplained peculiarities in the behavior of alternate currents), I should say that the true voltage must be quite high. They do not behave like currents of low voltage (say 300 or 400), as they can be and practically are conducted over much longer lines and thinner wires than is the case with the direct currents of say 1,000 volts. This fact is acknowledged as well by the enemies as by the friends of the alternate current system. Experiments made with converters, especially with a new and very peculiar one of my own construction, appear also to show that there must be considerable voltage in the alternate currents so as to account for the generation of the enormous volume of current into which the electro-motive force is converted; in other words, for the thousands of amperes obtained by the conversion of the volts of the primary current, and for which amperes there is no ammeter yet to measure them, but their volume shows itself in the capacity to perform operations requiring the highest temperatures, such as welding iron, fusing the most refractory substances, etc.

Surely no dynamo could be constructed directly generating a current of such volume, as it would destroy itself by the heat of its own current; it is only by alternating current machines of high voltage, assisted by proper converters, that currents of such great volume and high caloric capacity can be obtained.

After all, we must not lose sight of the main object in this controversy, which is: the comparative danger lurking in the two systems. When it is found by experience that actually the danger of being killed is greater by the use of alternate currents, it does not make any difference if the voltage which does the killing is 300 or 1,300.

When, however, we consider that statistics show that the loss of life by the direct current system is continually increasing in proportion that the system is extending, the probabilities appear to be that both systems will furnish their equal quota of victims, and the labor of comparing the relative danger of both systems, and especially the discussion about their comparative voltage appears to become an idle occupation.

All the opposition of the alarmists who predict terrible disasters from the introduction of the alternate currents, will have about the same influence as was the case with those who almost a century ago warned the world against the introduction of illuminating gas and railroad trains; the gas and the railroads have come to stay, and so will the high tension currents. The progress of the world cannot be arrested by a few timid alarmists.

Disruptive Discharges and Their Relations to Underground Cables.

BY E. G. ACHESON.

From among the numerous problems that are earnestly calling for solution, before perfection can be claimed in underground systems of electrical distribution for arc lighting, I selected as the one presenting probably the greatest importance, and, consequently, the one most desirable to solve: *The determination of the cause and cure of the frequent puncturing of the insulation, especially at the terminals, of lead encased conductors when carrying high potential currents.*

In a communication to the electrical press, published July 7th, 1888, under the title, "The Influence of the Condenser on Disruptive Discharges," a detailed description of a series of experiments on the discharge between points in air was given; they having been made with varying E. M. Fs., and condenser capacities.

These experiments resulted in the formulation of the general law expressed in the equation:

$$\frac{\text{(E. M. F.)}^2 \text{ charge in coulombs}}{a} = d,$$

or

$$\frac{\text{(E. M. F.)}^2 \text{ capacity}}{a} = d,$$

where a is a constant for the dielectric, and d is the spark length, the charge being expressed in coulombs and the capacity in farads. In the same article, the value of a was taken as 135, and d was expressed in inches.

While these experiments may serve as a basis or foundation to build upon, much more must be known before they will meet the requirements of the engineer operating with high potential currents, and with the object in view of obtaining at least a small portion of this required information, my experiments were extended into the more practical part of the subject, and furnished the results I have embodied in this paper.

The most probable condition of a discharge in a cable would be between the cylindrical conductor and a point or projection on the lead covering, hence the first point to determine was the striking distance between such a cylindrical body and a projection or point.

Experiments were made with a point and the side of a wire, two sizes of the latter being used, a No. 8 and a No. 16 B. & S. wire gauge. There was no difference between the results obtained with the two sizes. The length of the spark was found to be about 55 per cent. when compared with that produced between points with the same E. M. F. and capacity.

This difference gives a new value for the constant a, which is found to be 263.

The equation for a spark length between a point and a cylinder will therefore be

$$\frac{\text{(E. M. F.) capacity } d.}{263}$$

The following approximate values of a have been determined, for the conditions and dielectric specified, d being expressed in inches:

Dielectric.	Spark between	a.
Air	Points	135
Air	Points and wire	263
Paraffine and cotton	Point and wire	5,822
Ozite and cotton	Point and wire	7,759

The conditions governing the possible disruptive discharge, through the insulation of the lead covered, grounded cable, are so numerous that it would be quite impossible to exhaustively consider them, even if the necessary data were at hand, within the limits of this paper. It will, therefore, be necessary to confine the subject to the more important conditions, and the exposition of the law by means of a case that might be found in practical work.

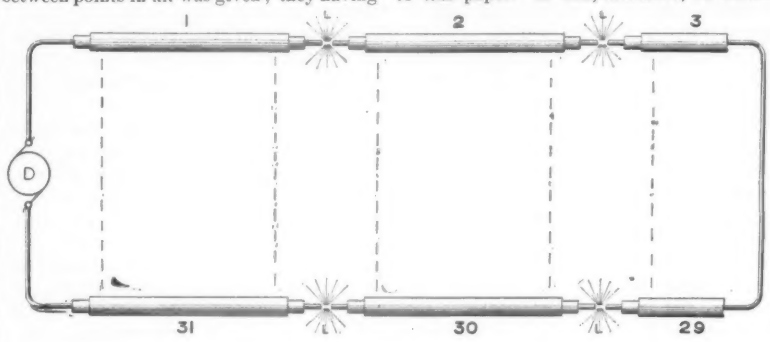

FIGURE 1

In Fig. 1 is illustrated a portion of an arc light circuit, consisting of the dynamo, D, and 30 lamps, L, connected in series by a lead-covered underground cable. For the purposes of illustration and calculation, it is assumed that the lamps are separated a uniform distance of 300 feet; the size of the conductor, a No. 4 B. & S. wire gauge, insulated with one-tenth of an inch of cotton and paraffine; the capacity per mile is 0.704 of a microfarad, and the E. M. F. at the brushes of the dynamo, 1,500 volts. Also as an assistance in calculation, it is supposed that the drop in the E. M. F. occurs in the lamps only.

The capacity of each one of the 31 sections of cable separating the lamps and dynamo and which are numbered in regular order from 1 to 31, will be 0.04 of a microfarad, and the capacity of each division, from conductor to conductor across the circuit, as as between sections 2–30 will be,

$$\frac{.04 \times .04}{-.04 + .04} = .02 \text{ microfarad},$$

or in this case one-half that of one side.

With these conditions each division, composed of the paired sections, as 1–31, 2–30, 3–29, and so on, will have a potential tending to break through the insulation of the lead, and thence across the intervening medium in the direction of the broken lines, of a value of 1,500 volts at 1–31, and decreasing by 100 volts for each succeeding division.

These various potentials will, provided the insulation is perfect and the leads well grounded, induce a static charge between the conductor and the lead of each section, of a value measured by the potential across the division, and the specific inductive capacity and thickness of the insulating material.

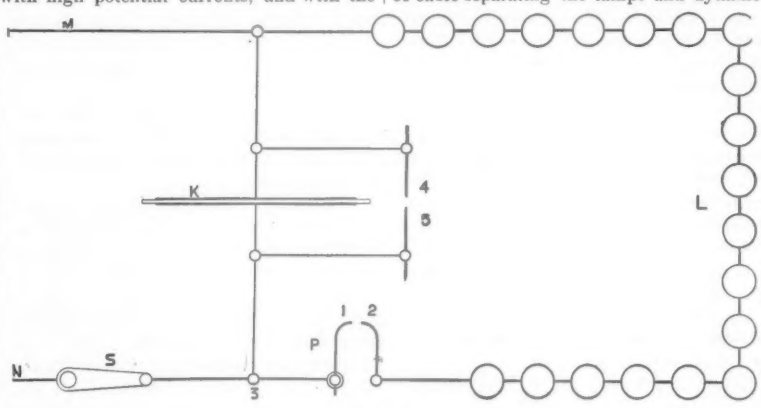

FIGURE 2

In the case under consideration, the thickness of the insulation and the specific inductive capacity are such as to induce a condenser capacity of .02 of a microfarad, and with an E. M. F. of 1,400 volts, as would exist between 2–30, the charge would be 1,400 × .02 m. f., .000028 of a coulomb; and if the conductors forming the two sides of this division should, while in this charged state, be insulated from each other, as might be done by breaking the electrical continuity at both ends of either one of the sides, the energy stored within it would be able to produce a disruptive charge through air, from the conductors to a point, or *vice versa*, equal to

$$\frac{(1{,}400)^2 \ .000028}{263} = .2087 \text{ inch.}$$

This is almost two and a tenth times the thickness of the insulation; but the thickness of cotton and paraffine, composing the insulation of the cable, that this energy would pierce would be:

$$\frac{(1{,}400)^2 \ .000028}{5822} = .0094 \text{ inch.}$$

or less than one-tenth of the thickness of the insulation.

Two questions now present themselves: First, are the sides of division 2–30, or any one of the others, liable to become insulated from each other, or attain a condition favorable for a discharge, or will there not always be a path open for discharge around the circuit, either by way of the lamps or the dynamo? The second question may be stated thus: Is it probable, with the conditions of the case above taken, that the insulation will ever be pierced, seeing that the discharge through the insulating medium cannot be greater than .0094 of an inch, whereas the thickness of the insulation is 0.1 of an inch?

It is evident that from accidental causes, such as the breaking of the circuit at two points, it is possible to have the two sides of the division insulated from each other; but such accidents are not liable to occur, especially when it is remembered that the breaks would have to be made simultaneously. To make the probability of this action occurring worthy of consideration, other means of producing it must be looked for and found.

On a circuit using coils shunted around the arc, the electrical continuity is established at each end of the two sides of the division, by one of these coils and the arc.

From the experiments of various experimenters, prominent among whom may be mentioned Prof. Hughes and Dr. Oliver Lodge, it is concluded that the self-induction in these coils would be of such a value as to offer an almost insurmountable barrier to the flow of the charge through them; and this being the case, the discharge, if it occurs at all, must be through either the arc or the insulation of the cable. To determine whether the charge would pass off through the arc, the apparatus shown in Fig. 2 was used. Twenty incandescent lamps, L L, of 100 volts each, were connected in series to the lines, M N; in the line N was placed the switch, S, and the contact points, 1 and 2, the former being mounted in the revolving post, P, thereby permitting of the points being opened; the condenser, K, was connected across the circuit from the line, M, at a point, 3, between the switch and the contact points, on the line, N; around the condenser were placed the points 4 and 5, with suitable means of regulating the distance between them. M and N were connected to the two sides of a transformer supplying an E. M. F. of 2,067 volts. The points 1 and 2 being in contact, no amount of rupturing of the circuit at S, and adjusting of the space separating 4 and 5, would cause a discharge to occur between them; but upon opening the points 1 and 2 and thus establishing an arc in the circuit, the opening of the switch, S, would cause a heavy discharge between 4 and 5.

From this experiment and Dr. Lodge's results with circuits containing self-induction, the conclusion must be drawn, that conditions favorable to a disruptive discharge are exceedingly likely to occur, that upon opening an arc light circuit the various sections of the cable become, so far as the static charge is concerned, insulated from each other.

In considering the second question, the fact is at once recognized, that where the constant, a, for the dielectric surrounding the conductor is that of the cotton and the paraffine, a disruptive discharge would, under the circumstances cited, be impossible; and the answering of the question in the affirmative will therefore turn upon the probable lowering of the value of a.

Any one familiar with insulations as applied to conductors, knows that all of them, with the exception of rubber and gutta percha and their compounds, will permit water or moisture to penetrate them, and as the hydro-carbons and water do not form chemical compounds, the one being insoluble in the other, this passage of the water must be a purely mechanical action, and furthermore, openings, cracks or crevices must exist in order to permit of its passage. In many cases the cracks are visible to the eye, while in others they can only be de-

tected by submerging the insulated conductor in water for a time, and then testing electrically. But even after proving the existence of these cracks, it remains to be determined that the static charge will be influenced by them.

As one means of testing the case, a plate of glass .072 of an inch thick was broken into two pieces, and the two parts immediately fitted into their former positions, and held together by clamps. The crevice or space separating the parts was infinitesimal in width, as will be evident to any one who may have made a similar experiment. The restored plate was placed between two discharge points, in such a position that the line joining the points passed through solid glass. Under these conditions I was not able, with my facilities, to cause a disruptive discharge to take place through the plate; but upon moving it so that the line joining the points would lay in the plane of the fracture, a disruptive discharge occurred with an E. M. F. of 2,067 volts, and a capacity in the circuit of .00322 of a microfarad.

While this demonstrates the minuteness of the path required for a discharge, it is hardly a parallel case to what would exist in an insulated conductor, where the insulation was built up out of many over lapping windings of fibrous material and then treated with an insulating compound, for in this case the cracks or crevices produced by temperature variations and the bending incident to handling and laying of the conductor will not be direct lines or planes from the conductor to the metallic casing, but angle or zigzag lines, following the interstices of the fibrous structure; this difference would result in the lengthening of the path of discharge, but, scarcely to an extent sufficient to raise the resistance to discharge, to the value of the insulating material in a perfect state; and so long as the value is below that of the insulating material the value of the constant a is also lowered, and it is therefore reasonable to assume that the conditions may become such as to warrant an affirmative answer to the second question.

Unfortunately both of the two grand divisions of conductor insulators, the fibrous and the non-fibrous, have their faults, for while the fibrous has the, in some circumstances, serious fault of cracking, the non-fibrous has the even greater fault of losing its insulating qualities and running off the conductor, when heated, as might occur by an accidental over loading of a circuit, and when is is confined, as in a lead covering, it permits the conductor to become decentralized and eventually come in contact with the lead casing. Between the two insulators, with the faults specified, inseparably associated with them, there would, for high potential currents, be little or no choice, but fortunately means have been devised whereby the existence of the cracks or crevices in the fibrous insulating envelopes, when properly protected from water by a metallic casing, is immaterial, as they are sheared of the power of diverting the discharge into the paths opened by them.

These ends are accomplished by the simple expedient of causing the discharge to occur at such a place and in such a manner as not to pass through the insulating envelope.

This may be done in a great variety of ways, but the most simple one that has suggested itself to me, is shown in Fig. 3, where A is the lead covering; I the insulation; C the conductor; and P a wire connected to A and extending out beyond I, its end K being adjusted in relation to C so as to leave an air space slightly less than the thickness of the insulating material I. Under these conditions when a discharge occurs it will invariably be at K and not through I.

While this simple arrangement illustrates the action and answers as a means of protection, it is evident that some device more durable and capable of adjustment would be preferable. A design meeting these requirements is shown in Fig. 4.

In the figure, A is the lead covering; I the insulation, and C the conductor. Mounted on the lead A and held in place by the band V, is the the metallic arm P, carrying at its outer end the pointed rod R. Another pointed rod R, is held by a projection on the ring B which is mounted on the insulating brush D. A fusible wire F connects the ring B to the metallic sleeve or collar E. The distance between the points R and R', can be adjusted and the rods held in position by suitable screws.

It is evident that the operation would be similar to that of the device shown in Fig. 3. The electrical potential between the conductor C and the lead covering A before attaining a height sufficient to discharge through the insulation I, will discharge across the air space between the rods R and R', for these rods being in electrical connection with A and C will attain their potentials, and the points of the rods, will according to known law have an electrical density above that of A and C or that requisite to produce a discharge accross the intervening air. The fusible wire F is inserted as protection against injury to dynamos and cables in case of a ground existing on the other side of the circuit.

There are several points, apparently trivial, but really of much importance, relating to the design and material of construction of a device for discharging a cable.

The distance, measured on the exposed surface, separating the points of support of the discharging arms or rods, should be as great as possible, as there would be a loss of energy, across this space, in case the distance was small and dampness existed. Another point to remember is that the constant a should have a known value, and therefore the most appropriate design for the discharger is one employing points to discharge from and an unvarying intervening medium, such as air.

In order to obtain some definite information on the question raised by Mr. Leggett at the Pittsburgh meeting, as to the effect on the insulation, of a short bend or indentation in the lead of a cable; I caused a very deep dent to be made in a cable, so deep in fact that it would at once have been condemned in practical work, and then connecting it into the working circuit, an attempt was made to cause a disruptive discharge to pass through the compressed insulation at the point of indentation, but the attempt was unsuccessful, the discharge preferring to occur at any other point.

Another experiment was made to determine

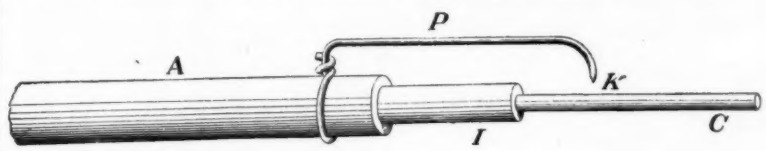

FIGURE 3

the effect of bending the cable backwards and forwards several times in the same place. A length was selected in which the discharge always occurred at either one of the ends, and after the bending operation had been performed a number of times, I was able to produce the discharge through the bent portion in preference to the terminals.

These tests show the superior strength of the insulation in the more condensed or homogeneous forms, and the weakening effect of much bending.

In this connection it may be well to inquire more fully into the tendency of the discharge to occur at the terminals of the lead.

It is a well-known fact that the greater number of the grounds or burn-outs that occur on arc light circuits are at the terminals of the lead, or at the joints, and it is precisely at these points that the charge, acting under well established and familiar laws, would be most dense, and owing to the presence of the edges or points for the electricity to flow from, the disruptive discharge will, under ordinary circumstances, take place between the edges or points, and the conductor within the insulation. Owing to the special facilities offered at these places for the passage of the discharge, it is probable that in many cases burn-outs occur under the influence of a charge that would be unable

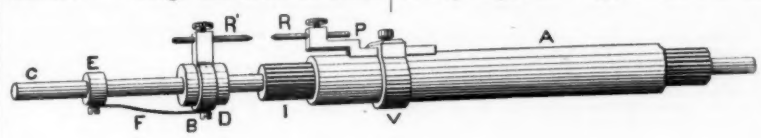

FIGURE 4

to produce a discharge through the continuous portions of the cable.

In order to reduce the probability of a discharge occurring at terminals and joints, I would suggest that the lead whenever cut be made bell shape, in order that all edges or points be turned away from the conductor.

It may be appropriate at this point to consider, briefly, that vexed question, "Which way does the spark pass?"

There is a relic of the past ages still existing, to a greater or less extent, among those who are unfamiliar with the present state of electrical science, and which, I have no doubt, many, if not all, of you have heard. The favorite way of expressing it is thus: "*The earth is the home of electricity, and it is continually striving to get there by the quickest and shortest route.*"

By this theory the electricity, as represented by the spark, would always jump from the conductor to the lead and thence pass to the earth.

It is plain to see the great weight this would have in an argument against the near approach of the conductor to the earth as is necessitated in the underground system of distribution.

The direction of the discharge is determined by the form or figure of the charged bodies and the characters or signs of the charges on them, the earth playing no part other than that of a conducting medium.

On an underground system there is, the moment before a disruptive discharge occurs, an unstable equilibrium between two points of the system or rather of the conductors forming the system and the insulations or dielectrics separating them. Through the line joining the points there is a strain produced by the difference of potential of the points, the tendency being to a neutralization of the potential differences. Against this strain is opposed the resisting power of the dielectric intervening (and usually consisting of the insulations on the conductors and the earth which separates them). The disruptive discharge that follows may be either from a conductor to the earth or the reverse, but in neither case is there the slightest quantity of electricity left in the earth as a result of the discharge. It is a transmission of energy from one point of the system to another of a different potential and the amount of electrical energy lost in the passage is expended in overcoming the resistance, and appears as heat.

From the experiments and conclusions of Faraday, I have made the following deductions:

1st. When the charged bodies are of the same size and form, the *spark discharge* will, other things being equal, be *from* the positively charged body.

2d. Other things being equal, less potential is required to produce a *brush discharg* than a *spark discharge*, and when it does occur, it will be free from the negatively charged surface.

3d. In all cases where the charge of electricity is on, or closely associated with the discharging surfaces, a diminution of either surface will facilitate a discharge, and when any considerable difference exists in their areas, the discharge will always be *from* the smaller surface.

4th. A spark from a small body to a large one, will be from eight to ten times greater in length, when the small body is charged positively, than it would be with a negative charge. In general, the direction of the discharge between the conductor and the lead, through the insulation, is subject to the form of the surfaces of the conducting bodies; a slight burr or point on either one being sufficient to determine the direction of the spark.

In a series of very interesting articles by Mr. G. L. Addenbrooke in the London *Electrical Review*, the subject of spark length, disruptive discharges and the advantages of a perfectly continuous and unbroken dielectric are extensively treated. The influence of the capacity of the cable is, however, entirely neglected. Special stress is laid upon the advantages of a continuous envelope of insulation, and those using rubber-covered conductors are particularly cautioned against handling or bending them when the temperature is lower than 45 degrees Fahr., as fissures or cracks are then liable to occur and permit of the passage of discharges.

This I confess was information to me, and puts a certain limitation to the qualities I have given above to rubber and which was written before this statement of Mr. Addenbrooke's cane into my hands.

As the experiments referred to in this paper have extended over a considerable period (not less than six months), there have naturally been a number of questions and points presented themselves from outside sources. Others have been led into the field to experiment, and with the equally natural result of obtaining in some cases effects that they have construed to be at variance with those I have secured. I have one case in mind where the experimenters found it impossible to proudce a disruptive discharge so long as the lead of the cable was insulated from the ground, but the grounding of it made the production of the discharge feasible, and they concluded that the theory of a disruptive discharge was not correct. This is a repetition, under different conditions, of the very old experiment of attempting to charge a Leyden jar with the jar insulated. The first condition to be arrived at in the charging of a jar is the grounding of one of the surfaces.

A disruptive discharge through the insulation of the cable, cannot occur without a charge being first formed, hence, it is absolutely necessary that a ground be made to the lead.

The spark discharge is all but instantaneous in its action, and with the work restricted to this immeasurably short space of time, it is necessary to have the energy on hand, as it were; there is no time to generate it electrically at the dynamo, and convey it over long, or even short distances.

The subject of disruptive discharges with various resistances and self-induction placed in the path of energy, is beautifully treated in a paper read by Dr. Oliver Lodge before the Society of Arts, April 17th.

One word more before closing this subject. It is safe to predict, that the disruptive discharge being provided for, little or nothing more would be heard of the much talked of pin holes in the lead, and the moisture absorbing terminals; the undergrounding of arc light cables would become a thing of certainty, and our municipal governments relieved of a great bug-a-boo.

Some Methods of Electrical Measurement.

BY G. A. LIEBIG, JR.

Among the requirements of modern electrical engineering and the usual practical work in electricity is the ability to make accurate and reliable measurements of the current, of potential, of capacity, etc. And with the growth of practical electricity itself goes hand in hand the increasing necessity of instruments of precision and standard apparatus with which the various appliances in every day use may from time to time be compared.

It may not be out of place therefore to give a brief account of some methods of measurement and comparison, many of which have been thoroughly tested, and one or two of which are believed to be new and more reliable than the methods hitherto applied. Let us discuss first of all the best manner of measuring *currents*.

Current determinations may very conveniently be divided into groups, *i. e.*, the measurement of heavy currents, and the measurement of small currents. Of the latter very little need be said, as the best method undoubtedly depends upon the use of an electro-dynamometer, and the most suitable form of such an instrument is that of the British Association, the well known Weleer electro-dynamometer, which has been thoroughly explained and mathematically treated at length by Maxwell. With two or more electro-dynamometers of this kind, currents, ranging from a few mill amperes, to 10 or 25 amperes, can readily be measured with an accuracy of one part in two or three thousand. Currents greater than this must be determined by some other arrangement, since a dynamometer capable of accurately measuring very heavy currents would have to be of massive proportions and of correspondingly increased cost. An instrument at the Johns Hopkins University which is intended to measure currents up to fifteen amperes has fixed coils one meter in diameter.

For heavy currents it has been found advisable to apply the method of "fixed resistances," a method which has been used and successively improved in several electrical exhibitions in this country and abroad, and the range of which is practically unlimited. In this method, the current to be measured traverses several heavy German silver bars which have been hard soldered to a pair of very large copper blocks to which are fastened, in the same way, the terminals of the galvanometer leads. The bars and end blocks are immersed in a tank of refined petroleum, and their temperature, by stirring constantly the oil, can be determined to a few hundredths of a degree. To use this apparatus a known current, measured by an electro dynamometer, is sent through the fixed resistance, and the potential at the ends determined by the galvanometer joined at these points. The deflection of the latter corresponding to any other current gives us at once a measure of the current. In practice, a resistance box is placed in circuit with the potential galvanometer and the resistances always adjusted until approximately the same deflection is obtained. By doing this we render ourselves independent of the assumption that the angular deviation of the galvanometer needle is proportional to the current, except for exceedingly small differences. It is to be noticed, however, that the calibrating current is measured by an electro-dynamometer, and not by a galvanometer, the reason being that the former is independent of the value of H (the earth's horizontal component), whereas any error in the determination of H appears directly in the galvanometer constant.

During the measurements the oil in the tank is constantly stirred and its temperature noted. As a matter of fact, this is found to change but little, even with currents of 200 amperes or more. Calling R^0 the resistance of the German silver bars at $0^0 C$; B, its temperature co-efficient; T and T^2, temperature of the same corresponding to current, C and C^2; D and D^2, V and V^2, t and t^2, the deflections of galvanometer, adjusted resistances, and their temperatures, corresponding to current, c and c^2, we have

$$C^2 = C, \frac{D^2(1 + xt^2)V^2.}{D^1(1 + xt1)V.} \frac{R^0(1 + BT,)}{R^0(1 + BT^2)},$$

x being the temperature co-efficient of the resistance box. The terms relating to changes of the resistance, R^0, *i. e.*, of the German silver bars can generally be neglected.

Potential measurements can be made in exactly the same general manner, the "fixed resistance" used for this purpose being, however, very much higher. A known current is passed through the German silver reel, forming the fixed resistance, and the deflection of the galvanometer joined to its ends is noted. A resistance box in circuit with the galvanometer enables us to reduce this deflection to a convenient angle. Care must be taken that the current used for calibrating the galvanometer be so small as to heat the fixed resistance as little as possible. After the calibration is completed the galvanometer is joined to points whose electro-motive force we wish to measure and the resistance box adjusted until the same deflection as before is secured. We have then an expression for the potential of exactly the same form as the one given before. For very high potentials the method is inapplicable and recourse must be had to an absolute electrometer of the kind first described by Sir Wm. Thomson. In this instrument, fully explained in Thomson's papers, the difference of potential between two points is measured by the attraction between two discs electrified to the same difference of potential, one of them being balanced by a series of weights, the other being fixed. With such an instrument electro-motive forces varying from 1,000 volts to over 100,000 volts can easily be measured, and it thus offers an excellent means of comparison with electrostatic voltmeters, etc.

There is perhaps no better way of measuring *resistances* than by the employment of some accurate and sensitive form of Wheatstone bridge. The only difficulty encountered in such measurements is the exact determination of the temperature of the various resistance coils, and standards in use during the work. It has been found absolutely necessary to immerse all the measuring coils in liquid during the use of the apparatus, and to allow them to remain in a room whose temperature is almost constant several hours before any measurements are made. Even thin glass tubes containing mercury and surrounded on all sides with cracked ice have been found to require at least five or six hours for their temperature to fall to zero.

The efficiency of dynamos and motors can be determined with all necessary accuracy by means of any one of several dynamometers of distinct types, and now well known, and the subject is one which presents no difficulty whatever until the attempt is made to measure the efficiency of very small machines—that is machines of one horse power and less. In these cases it has become necessary to devise a way of measuring which shall greatly reduce errors ordinarily encountered. The difficulty generally presented is that the dynamometer itself absorbs in friction so much energy that the loss thus occasioned amounts to a large proportion of the total activity of the machine under examination. The cradle dynamometer is perhaps free from this objection, but it must be rejected on account of the uncertain but large errors introduced by slight errors of centering. Hopkinson's method might be employed were it not that it requires two machines to experiment upon, an obstacle which in most cases would be a serious one. A method which appears to be devoid of the objections just enumerated is a modified calorimetric method. To employ this the motor or dynamo, as the case may be, is surrounded by an air-tight water jacket, through which circulates a stream of water at a uniform temperature. The dynamo is allowed to run under a given load until all the effects of heating have become constant; this includes the heating resulting from mechanical friction and from the current itself. After this the flow of water is determined, its temperature carefully noted, and from these data the losses occurring in the motor are at once deducible. There appears to be nothing in the way of making the method universally applicable to small machines, and the indications are that its adoption would lead to very accurate results. This method was first proposed by Dr. Duncan as a means of measuring the efficiency of alternating current converters.

Several methods of determining the magnetic qualities of iron and steel have been published. They all depend upon the measurement, by a ballistic galvanometer, of the induction through a coil wound about the specimen to be tested, either when the coil is moved, the current reversed or reduced to zero. These methods offer no difficulty, and a ballistic galvanometer can easily be calibrated in absolute measure by the use of an earth inductor or even a coil of wire of a few turns, its constants having been determined by measurement and simple calculation.

Names and Cities of Convention Attendants.

THE FOLLOWING GENTLEMEN ATTENDED THE SESSIONS OF THE ELECTRIC LIGHT CONVENTION, AUG. 29, 30 AND 31.

A

B. Abdank, Rep., El. Syn. Paris Inter. Ex. 1889.
A. Arango, Man., Edison Spanish Colonial El. Co.
F. E. Alexander, Sawyer-Man Co., Boston.
P. H. Alexander, Sawyer-Man Co., New York.
J. D. Ashton, Pettingell & Co., New York.
P. C. Ackerman Am. Elect. Wks., New York.
F. H. Angell, J. A. Roebling Sons & Co., New York.
E. A. Apgar, Westinghouse Elect. Co., Trenton.
M. P. Ayers, Pres., Jacksonville Gas Lt. & Cke. Co., Jacksonville, Ill.
Wm. A. Anthony, Mather Elect. Co., Manchester, Ct.
Chas. E. Apgar, New York.
E. G. Acheson, Stand. Undergrd. Cable Co., Pittsburgh, Pa.
M. F. Adams, New York.

B

D. H. Bates, Gen. Man., Elect. Accum. Co., New York.
T. H. Brady, Mast arms & Hoods, New Britain, Ct.
C. R. Botsford, Geneva Non. Mfg. Watch Co., New York.
L. F. Beckwith, Chief Engineer Cons. Elect. Subway Co., New York.
A. W. Butterworth, Simplex Elect. Co., Boston.
F. J. Boynton, N. E. Tel. & Tel. Co., Boston.
A. E. Bliss, Malden Ells. Lt. Co., & Thomson Welding Co., Boston.
G. H. Blaxter, Allegheny El. Lt. Co., Pittsburgh, Pa.
E. L. Bogert, Narragansett El. Lt. Co., Providence, R. I.
Jesse Bunnell, Bunnell & Co., New York.
Cyrus O. Baker, Jr., Baker & Co., Newark, N. J.
Chas. H. Bogle, Electric Age, New York.
J. L. Barclay, Holmes, Booth & Haydens, New York.
H. M. Byllesby, Gen. Man., Westinghouse El. Co., Pittsburgh, Pa.
C. A. Brown, Western El. Co., Chicago, Ill.
G. W. Blanchard, Solar Carbon & Mfg. Co., Pittsburgh, Pa.
Geo. L. Beetle, Western Elect. Co., Chicago, Ill.
David Brooks, Brooks Undergrd. Tel. Const. Co., Philadelphia.
J. R. Burdick, Western Agent, Callender Insu. Co., Chicago.
Chas. S. Bradley, Elect. Engineer, Yonkers, N. Y.
C. H. Barney, Sawyer-Man El. Co., New York.
W. H. Boulton, Cleveland.
M. E. Baird, Eddy Elect Co., Windsor, Ct.
H. D. Brukins, Chicago.
K D. Bishop, Cleveland, Ohio.
J. Y. Bradbury, Lowell, Mass.
F. L. Bigelow, New Haven, Ct.
W. W. Biddelph, New York.
E. G. Bernard, Utica, N. Y.
H. W. Blake, Sprague Motor Co., Boston, Mass.
W. C. Brown, New York.
M. H. Barker, Boston.
C. S. Britton, Cleveland.
J. Y. Bradbury, Jr. Lowell, Mass.

C

James H. Cross, Sec. & Supt. El. Lt. & P. Co., Johnstown, N. Y.
H. B. Cram, Treas. & Gen. Man. Bernstein El. Lt. Mfg. Co., Boston.
Geo F. Curtiss, Thomson-Houston El. Co., Boston.
E. V. Cherry, Pres. Standard Elect. Wks., Cincinnati.
W. F. Collins, N. E. Rep. Callender Insu. Co., Boston.
J. Calisch, Elect. Accum. Co., New York.
David Chalmers, Empire City El. Co., New York.
J. B. Crouse, Standard Carbon Co., Cleveland, Ohio.
Lafayette Cole, Jenney El. Lt. & P. Co., Peoria, Ill.
W. F. Cullen, E. P. Gleason Mfg. Co., New York.
H. A. Cleverly, Cleverly El. Wks., Philadelphia.
A. C. Chenoweth, New York.
F. E. Clark, Campbell Elec. Supply Co., Boston.
F. G. Cartwright, Mutual Elec. Const. Co., New York.
H. H. Cutler, Newton Elect. Lt. & P. Co., Newton, Mass.
Robert Coleman, Union Indur. Fibre Co., New York.
W. R. Caulkins, T.-H. Carbon Co., Fremont, Ohio.
E. H. Cutler, Elektron Mfg. Co., New York.
J. J. Carty, Western El. Co., New York.
G. B. Coggeshall, The Mitchell Vance Co., New York.
C. C. Curtiss, Brush Elect. Co., Cleveland.
W. M. Callender, Callender Insu. Co., New York.
Addison Conkling, Anti-Magnetic Shield, New York.
H. N. Curtis, Sawyer-Man Co., New York.
W. L. Candee, Okonite Co., New York.
F. R. Colvin, Balto.
Walter P. Clark, Boston.
John Claffy, American Cement Conduit Co., New York.
J. M. Candee, Poughkeepsie, N. Y.
Henry Carman, Rahway, N. J.
H. Crocker, New York.
M. Coombs, Youngstown, Ohio.
E. P. Clark, New York.
B. F. Card, Harrison, N. J.
C. A. Cheever, Okonite Co., New York.
W. D. Cadwell, Nashua, N. H.
J. R. Curtair, New York.
S. E. Cox, Cleveland, Ohio.
E. W. Carritt, Empire City Elect. Co., New York.

D

James R. Dee, Man., Peninsular El. Lt. & P. Co., Houghton, Mich.
W. H. Druckemiller, Penn. R. R., Sunbury, Pa.
Fred. DeLand, Elect. Supply Co., Chicago.
L. W. Dillon, N. Attleboro Steam & El. Co., N. Attleboro, Mass.
A. J. DeCamp, Brush Elect. Co., Philadelphia.
S. A. Duncan, Allegheny Co. Lt. Co., Pittsburgh.
Henry C. Davis, Sawyer-Man Elect. Co., New York.
P. A. Dowd, Sprague Motor Co., New York.
F. E. Degenhart, Standard Underground Cable Co., Chicago.
Isaac H. Davis, New York.
A. L. Dunton, Philadelphia.
D. W. Dunn, Thomson-Houston Co., Boston.
H. M. Daggett, Jr., N. Attleboro.

E

H. H. Eustis, Electrician Eastern El. Cable Co. Boston.
C. L. Edgar, Supt. Edison Co., Boston.
B. Edwards, *The American Contractor*, New York.
F. E. Eaker, *The American Contractor*, New York.
J. F. Eliot, New York.
D. E. Evans, Baxter Motor Co., Baltimore.
Jarvis B. Edson, Edson Recording Gauge, New York.
D. W. Edgecomb, New York.
James English, New Haven, Ct.
S. F. Eagan, Buffalo, N. Y.

F

A. R. Foote, Sec. Queen City Elect. Co., Cincinnati.
M. J. Francisco, Rutland, El. Lt. Co., Rutland, Vt.
W. H. Fitzgerald, Brush El. Lt. Co., Detroit
C. J. Field, Edison United Mfg. Co., New York.
G. H. Fisher, Chas. A. Schieren & Co., New York.
W. O. Faulkner, Govt. Electrician, Honolulu.
S. J. Fox, National Pipe Bending Co., New Haven.
Hasegara Fee, Tokio, Japan.
J. Ferguson, Brooklyn.
W. H. Fleming, Decatur, Ala.
H. N. Fenner, Treas. N. E. Butt Co., Providence.

G

C. A. Gates, Russell Engine Co., Massillon, Ohio.
E. F. Gennert, E. P. Gleason Mfg. Co., New York.
A. V. Garratt, Modern Lt. & Heat, Boston.
P. R. Green, N. Y. Hyd. Cement Conduit Co., New York.
Henry Greer, School of Electricity, New York.
J. W. Godfrey, Gen. Man. N. Y. Insu. Wire Co., New York.
J. R. Gore, Gore El. Co., Philadelphia.
E. B. Gethin, Cleveland.
M. W. Goodyear, E. S. Greeley Co., New York.
W. A. Giles, New York.
M. B. Gisborne, New York.
H. R. Garden, Cons. Elect. Light Co., New York.
C. K. Giles, Anti-Magnetic Shield Co., Chicago.
D. L. Gibbens, Board of Elect. Control, New York.
G. H. Guy, New York.
J. Garnett, St. Louis.
R. E. Gallaher, N. Y. Insulated Wire Co., New York.

H

Henry Hine, U. S. Elect. Lt. Co., New York.
William Hood, Elect. Accum. Co., New York.
R. S. Hubbell, Non-Magnetic Watch Co., New York.
F. H. Hayward, Straight Line Engine Co., New York.
C. R. Huntley (and wife), Sec. and Gen. Mgr. Brush Elect. Light Co., Buffalo, N. Y.
C. I. Hague, Campbell Elect. Supply Co., New York.
C. S. Haley, Brush Elect. Light Co., Boston.
W. H. Harding, Baxter Motor Co., Baltimore.
W. S. Hammond, Greenport El. Lt. & P. Co., Greenport, N. Y.
Sam'l J. Hart, La. El. Lt. & Pow. Co., New Orleans, La.
Vitalis Himmer, Dr. Gassner Dry Battery, New York.
D. N. Hurlbut, Hurlbut Flexible Conduits, New York.
R. H. C. Hill, Pres. Brush Elect. Co., Philadelphia. Pa.
F. W. Harrington, Western Elect. Co., New York.
H. McL. Harding, Sprague Motor Co., New York.
John H. Hapgood, Elect. Construction Co., New York.
Walter T. Hunt, New York.
Hon. Jacob Hess, New York.
H. E. Hayes, Cleveland, O.
R. O. Heinrich, Philadelphia, Pa.
C. Hering, Philadelphia, Pa.
Prof. E. J. Houston, Philadelphia, Pa.
J. S. Hoffecker, Wilmington, Del.

I

Charles L. Ireson, Leather Links Belting, Boston.

J

William F. Jackson, Elect. Accum. Co., Newark, N. J.
Col. Jno. Jameson, Subway Commission, New York.
H. H. Johnson, Supt. Hartford Elect. Lt. Co., Hartford, Ct.
G. A. Johnson, Hartford, Ct.
W. J. Johnston, *Electrical World*, New York.

K

A. A. Knudson, New Bruns. Tel. Co., St. Johns, N. B.
Chas. C. King, Alfred F. Moore, Philadelphia.
F. E. Kinsman, Elect. Const. & Supply Co., New York.
Fred. A. Kinsman, Elect. Const. & Supply Co., New York.
P. O. Keilholtz, Baxter Motor Co., Baltimore.
W. A. Kreidler, *Western Electrician*, Chicago.
D. Killicutt, Insurance Exchange, Boston.
E. R. Knowles, Brooklyn.
W. H. Kelly, New York.
F. W. King, Baltimore.
H. Kearney, New York.
J. F. Kelly, U. S. Elect. Lt. Co., New York.
C. J. Kintner, New York.

L

Z. Latshaw, Elec. Accum. Co., New York.
E. A. Leslie, Subway Com., New York.
F. H. Leonard, T.-H. E. Co., Boston.
W. H. Laurence, Natl. Carbon Co., Cleveland, O.
H. L. Lufkin, C. & C. Elec. Motor Co., New York.
M. D. Law, Brush Elect. Co., Philadelphia.
Geo. R. Lean, Sun Elect. Co., Woburn, Mass.
A. B. Laurence, Underwood Mfg. Co., New York.
H. E. Longwell, Westinghouse, Church, Kerr & Co., Chicago.
Theodore Larbig, Holmes, Booth & Haydens, N. Y.
W. A. Locke, Ansonia Brass & Copper Co., N. Y.
E. T. Lynch, Jr., New York.
G. W. La Rue, Sprague Motor Co., New York.
James Larkin, Baltimore.
O Lugo, New York.
J. Logan, Waltham, Mass.
J. Lane, New York.
G. R. Lear, Boston.
H. M. Linnell, Hartford Dynamic Co., Hartford.

M

Morris W. Mead, Supt. Bureau of Elec., Pittsburgh, Pa.
W. H. Moore, Man. Plainfield El. Lt. Co., Plainfield, N. J.
Alfred F. Moore, Insulated Wire, Philadelphia.
R. D. McGonnigle, Allegheny El. Lt. Co., Pittsburgh.
Geo. A. Mayo, Van Depoele Mfg. Co., Chicago.
D. L. Mitchell, Taunton Wire Rolling Co., Taunton, Mass.
Walter C. McIntire, Agt. Eddy El. Co., Philadelphia.
M. D. Mather, A. W. Light and Power Co., Austin, Tex.
G. S. Mumford, C. & C. Elect. Motor Co., New York.
Edwin D. Mullen, Thomson-Houston El. Co., Philadelphia.
F. A. Magee, E. S. Greeley Co., New York.
T. J. McTighe, ELECTRICAL REVIEW, New York.
Dr. A. F. Mason. Gen. Man. Simplex El. Co., Boston.
T. McCoubray, Baxter Motor Co., New York.
J. Frank Morrison, Brush Elect. Co., Baltimore.
George T. Manson, Okonite Co., New York.
T. C. Martin, *Electrical World*, New York.
Dr. Otto A. Moses, New York.
Norman McCarty, Baxter Motor Co., Baltimore.
J. P. McQuaide, New York.
O. E. Madden, Empire City Elect. Co., New York.
R. T. McDonald, Jenney El. Co., Fort Wayne, Ind.
J. J. Moore, New York.
W. H. McGrath. Brush Illum. Co., New York.
R. W. Martin, New York.
E. A. Marsh, Waltham, Mass.
J. C. Minahan, Troy, New York.
R. L. Morris, Nashville, Tenn.
Theodore Moss, Board of Elect. Control, New York
W. J. Morrison, Toronto, Ont.
J. Markland, Lowell, Mass.
C. H. McIntire, Newark, N. J.
R. R. Moffatt, New York.
Theo. Mace, Harrison, N. J.

N

B. B. Nostrand, Jr., U. S. Elec. Lt. Co., New York.
John F. Noonan, Patterson, N. J.
A. D. Newton, Eddy Elect. Mfg. Co., Windsor, Ct.
E. L. Nichols, Ithaca, N. Y.

O

T. Officer, Council Bluffs, Iowa.
J. F. Olcott, New York.

P

F. E. Pettingell, Electrical Supplies, Boston.
Albert C. Pond. Pres., Simplex Elec. Co., Boston.
H. M. Potter, Straight Line Engine Co., New York.
Geo. F. Porter, Faraday Carbon Co., Pittsburgh, Pa.
E. F. Phillips, Am. Elect. Wks., Providence, R. I.
M. J. Perry, Narragansett Electric Lt. Co., Providence, R. I.
A. H. Patterson, Phœnix Glass Wks., New York.
Chas. W. Price, ELECTRICAL REVIEW, New York.
E. F Peck, Citizens El. Illum. Co., Brooklyn, N. Y.
Ropt. J. Pratt, Elect. Mfg. Co., Troy, N. Y., Greenbush, N. Y.
J. N. Pratt, Jarvis Eng. Co., Boston.
G. W. Parker, Parker Russell Mi. & Mfg. Co., St. Louis
N. T. Pulsifer, Mather Elect. Co., Manchester, Ct.
G. M. Plympton, Pres. Subway Com., Brooklyn.
D. P. Perry, Sperry Elect., Co. & Sun El. Co., Chicago
T. A. B. Putnam, Railway Cab. Elect. Lt. Co., N.Y.
Ralph W. Pope, New York.
George M. Phelps, The *Electrical Engineer*, N. Y.
J. M. Pendleton, New York.
Jarvis Patten, New York.
W. P. Phillips, Editor *Electrical Age*, New York.
C. L. Perry, New York.
Frank L. Pope, The *Electric Engineer*, New York.
H. W. Pope, Elizabeth, N. J.

R

L. H. Rogers, Elect. Accum. Co., New York.
Benj. Rhodes, Man. Brush Elec. Light Co., Niagara Falls, N. Y.
Frank Ridlon, Baxter Motor Co., Boston.
Reuben T. Robinson, Providence.
Fred. W. Royce, Royce & Marean, Washington, D.C.
Geo A. Redman, Brush El. Lt. Co. Rochester, N. Y.
C. M. Ransom, *Mod. Lt. and Heat*, Boston.
R. F. Ross, *Mod. Lt. and Heat*, Boston.
F. B. Rice, Rice Auto. Cut-off Engine, Buffalo, N.Y.
A. Rosenfield, New York.
Henry Reiber, McKeesport Lt. Co., McKeesport, Pa.
T. S. Reed, Electrician, Jersey City, N. J.
F. C. Rockwell, Bonsilate Box Co., Hartford.
P. A. Randall, Ft. Wayne Jenney Co., Ft. Wayne, Ind.
H. G. Rice, Vice Pres., Hill Electr. Wks., Cincinnati.
R. W. Ryan, New York.
D. R. Russell, Parker-Russell Mining & Mfg. Co.
W. A. Rosenbaum, New York.
A. H. Rennie, New York.
H. Richmond, New York.

S

Charles A. Schieren, Am Leather Link Belt, N.Y.
Frank G. Stone, Ansonia Brass & Copper Co., N.Y.
K. Sawai, Metropolitan Tel. Co., Tokio, Japan.
Jno. A. Seeley, Metropolitan Tel. Co., New York.
Wm. J. Sefton, Subway Commission, New York.
J. C. Smith, M. R. Muckle & Co., Philadelphia.
A. K. Stiles, Van Depoele M'f'g Co., Chicago.
William Spurgeon, Baltimore.
T. W. Sprague, ELECTRICAL REVIEW, Boston.
J. S. Scoville, Nat. Carbon Co., Cleveland.
E. M. Sanderson, Westinghouse Elect. Co., New York.
T. Carpenter Smith, Keystone El. Lt. & Pow. Co., Phil.
C. W. Spear Brush-Swan El. Lt. Co. of N.E. New York.
W. F. Swift, Brush El. Lt. Co., New York.
A. L. Salt, Western Elect. Co., New York.
H. B. Slater, Leadville, Colo.
L. Schlegelmilch, Schaefer El. M'f'g Co., Boston.
L. Schaefer, Schaefer El. M'f'g Co., Eoston.
S. G. Stiness, Pawt'k't Gas & El. Lt. Co., Pawtucket, R.I.
P. J. Sosa, New York.
W. D. Sargent, N. Y. & N. J. Tel. Co., New York.
H. W. Spang, Ball Elect. Lt. Co., New York.
A. C. Smith, Non-Magnetic Watch Co., New York.
C. E. Stump, *Electrical World*, New York.
J. H. Shay, Munson Belting Co., Chicago.
Arthur Steuart, Baltimore.
O. B. Shallenberger, Westinghouse Elec. Co., Pittsburgh.
M. M. M. Slattery, Ft. Wayne Jenney Elec. Co., Ft. Wayne, Ind.
E. A. Scott, Philadelphia.
A. M. Smith, Worcester.
T. T. Smythe, New York.
A. P. Seymour, Syracuse.
H. D. Stanley, Bridgeport Brass Co., Bridgeport, Ct.
U. H. W. Schenck, New York.
A. C. Shaw, New York.
C. D. Smith, New York.
F. Skinner, New York.
A. Shedlock, New York.
J. R. Simpson, Philadelphia.
G. H. Stockbridge, New York.
W. F. Smith, Philadelphia.
S. G. Stenck, Pawtucket.
F. Swift, Boston.
A. F. Stanley, Hazazer and Stanley, New York.

T

C. R. Truex, Asst.-Gen. Man. Elect. Acum Co., N.Y.
John B. Taltrall, *Electric Age*, N. Y.
R. B. Tabor, T.-H., Westinghouse and Sawyer-Man, New Bedford.
H. B. Thayer, Western Elect. Co., N. Y.
F. C. Timpson, Auburn, N. Y.
C. A. Terry, N. Y.
H. S. Thornberry, Montreal, Can.

V

H. S. Vanderbilt, Mutual Elect. Cons. Co., Utica, N. Y.
P. H. Van der Weyde, N. Y.
F. Van Rysselberghe, Brussels, Belgium.
Jonas Venström, *Electrical Engineer*, Orebro, Sweden.

W

E. T. Wightman, Supt. and Electrician, Danbury, El. Lt. Co., Danbury, Ct.
Geo. W. Walker, Elect. Accum. Co., New York.
G. L. Wiley, Standard U. Cable Co., New York.
S. S. Wheeler, Elect. Expert Subway Com., New York.
Fred. H. Whipple, Detroit.
Thomas Wallace, Wallace Tel. Co., New York.
Chas. H. Wead, Hartford Dynamic Co., Hartford, Ct.
Merle J. Wightman, Thomson-Houston Co., Lynn, Mass.
F. G. Waterhouse, Waterhouse El. Mfg. Co., Hartford, Ct.
A. G. Waterhouse, Waterhouse El. Mfg., Co., Hartford, Ct.
C. D. Warner, Standard Elect. Time Co., New Haven
G. A. Wilbur, Ft. Wayne Jenney Co., Philadelphia.
J. J. Williamson, Boston.
George Worthington, ELECTRICAL REVIEW, N. Y.
L. C. Whitney, Supt. Schuyler El. Lt. Co., New Britain.
Joseph Wetzler, *Electrical World*, New York.
E. R. Weeks, Kansas City Elect. Lt. Co., Kansas City.
Gilbert Wilkes, Baltimore.
F. H. Wilkins, Western Elect. Co., New York.
J. Williams, New York.
C. Wirt, New York.
G. T. Woods, Cincinnati, Ohio.
B. J. Warner, Brooklyn.
E. W. Wilson, New York.
C. H. Wilcox, New York.
J. A. Wetmore, Okonite Co., New York.

Z

E. O. Zwietusch, Western Elect. Co., New York.